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VETERINARY MEDICINE

AUGUST CONTENTS 1948

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BUY U. S. SAVINGS BONDS

Rest is the most widely employed agent in medicine. Notwithstanding great advances in therapy during recent years, nothing has been discovered to take the place of rest.

Every year malaria attacks 300 million persons and kills three million. Although 30,000 veterans, chiefly of the war in the Pacific, are still drawing disability compensation for malaria, there has been only one instance of a veteran transmitting the disease to another person.

Quinoline disphosphate and paludrine, two synthetic antimalarial drugs developed during the war to replace quinine, which was unavailable, are being tested at the Oklahoma Agricultural Experiment Station in the treatment of anaplasmosis. Incompleted trials indicate that the former is probably more effective than any treatment heretofore employed for this disease. However, animals that have recovered clinically from the disease remain carriers of the *Anaphlasma marginale* for an indefinite period.

The discovery of a new and, as yet, unnamed antibiotic agent was reported at the recent meeting of the Society of American Bacteriologists, by the discoverer, Dr. P. S. Tetrault of Purdue University. The new agent is made from a soil bacterium. It is effective against typhoid, food poisoning, dysentery and other organisms of the general group antagonized by streptomycin, over which it is believed to possess the advantages of lower toxicity and lesser after-effects.

Bovine trichomoniasis has been diagnosed in 41 states. The infected territory is believed to be extending and the prevalence increasing.

Who first developed Hybrid corn? A recent secretary of the USDA. Don't be too sure. The process of hybridizing corn was described and the advantages told in the *Prairie Farmer* in May 1861.

Of 40 patients suffering from dermatoses of various types, who had been resistant to previous treatment, 36 showed definite improvement following the use of water soluble chlorophyll; 32 of these being clinically cured. The chlorophyll relieved the itching and the burning of the lesions and gave surcease and comfort to the patients, many of whom had been in great discomfort for weeks or months. —Langley, W. D., and Morgan, W. S., *Pa. Med. J.*, p. 44, 51:2:112.

Chloromycetin Gives Promise Against Viruses

A report from the Army Medical Department Research and Graduate School states: "Chloromycetin is highly efficacious in the treatment of patients with scrub typhus. It is simple to administer and has not been found toxic for man."

Tsugtsugamushi (scrub typhus) is a rickettsial disease, the first to prove amenable to an antibiotic agent. Chloromycetin has proved beneficial to mice experimentally infected with several other strains of rickettsial and various viruses of the psittacosis-lymphogranuloma venereum group.

Travel Features for Those Attending the San Francisco A.V.M.A. Convention

This bridge, the longest in the world, was completed in 1936 at a cost of $78,000,000. It was estimated the tolls, 65 cents, would pay the bonds by 1976. Despite reduction of the toll to 25 cents it is now estimated the bonds will all be paid off by 1952. Within a decade of its completion traffic on this bridge was approaching its rated capacity of 80,000 vehicles a day. The portion of the bridge shown is twin suspension; the portion on the Oakland side of the island is cantilever construction. The length with the approach is 8¼ miles; length of the main structure 22,720 feet.

San Francisco-Oakland Bay Bridge Looking West from Yerba Buena.

Despite Kipling's aphorism, East and West do meet in San Francisco. Kipling himself said of San Francisco's Chinatown, "It is a ward of the City of Canton, set down in the most eligible business quarter of the city. The visitor is fascinated by this largest gathering of Chinese outside the Orient; colorful throngs with strange faces, sing-song voices and shuffling gait; magnificent museum shops crowded with Oriental wares; street bazaars with dwellings above and below. Even the food stalls are like no others. Fish stalls are almost a blaze of finny color. Hogs are roasted whole and the purchaser selects the chunk he will have, which is then cut out or off for him. Many herbs and vegetables imported from the Orient are displayed, and outlandish confections are for sale.

At the southeastern corner of Chinatown nestles Portsmouth Plaza where Captain Montgomery first raised the American flag above the village of Yerba Buena (July 8, 1846) and proclaimed the sovereignty of the United States. Here also the Vigilance Committee met (1851-1856) to mete out pioneer justice to the lawless. Here too, Robert Louis Stevenson sat many hours daily (in 1879) and listened to the incredible tales of mariners from the South Seas, the Orient, and literally the Seven Seas. San Francisco marks the end of Aryan and the beginning of Mongolian migrations.

Chinatown is visited by most tourists to San Francisco. It is a safe prediction that most of those making their first trips to the West Coast to attend the A.V.M.A. meeting August 16 to 19 will "do" Chinatown.

Faculty Changes at M. S. C.

Dr. E. T. Hallman, Professor and Head of the Department of Animal Pathology in the School of Veterinary Medicine, Michigan State College, will begin a one year leave of absence, July 1, 1948, prior to retirement July 1, 1949. Doctor Hallman has served on the faculty of Michigan State College 36 years.

Dr. R. A. Runnells, Professor and Head of the Department of Veterinary Anatomy, will be transferred to Professor and Head of the Department of Animal Pathology July 1, 1948.

Prof. B. B. Roseboom, Head of the Department of Physiology and Pharmacology, will begin a one year leave of absence July 1, 1948, prior to retirement July 1, 1949. Professor Roseboom has served Michigan State College 39 years.

Dr. B. V. Alfredson, professor in the department, will be promoted to Professor and Head of the Department of Physiology and Pharmacology July 1, 1948.

The position that Doctor Runnells will vacate July 1 has not yet been filled. Applicants possessing a degree of Ph.D. or D. Sc., in addition to a veterinary degree, will not be amiss in mentioning it.

Deficiency of pantothenic acid, one of the B group of vitamins, is signalized by dermatitis at the corners of the mouth, granulated eyelids, lesions of the spinal cord and infertile eggs.

Avian (Fowl) Pox

All birds are susceptible to fowl pox, but water fowl are rarely affected. The disease is due to a filterable virus and occurs chiefly in the autumn. The incubation period is usually seven to 14 days. The course may be acute or chronic and ordinarily runs from 14 to 28 days. Mortality varies from nothing to 50%, control measures comprise sanitation, insect control, and isolation but the main reliance is upon vaccination; using living fowl fox virus in young chickens and live pigeon pox virus in layers.

Fowl Pest (Peste)

All birds and probably most mammals are susceptible to the virus of fowl pest but natural occurences of the disease is chiefly in chickens. It affects chickens of all ages and at all seasons, but it less common in winter. The incubation period is short and the course acute; usually less than a week. Both the incidence and the case mortality is high in the infected flock, usually more than 90 and often 100%. The symptoms are diarrhea, weakness, dullness, coma, and death. Control comprises chiefly depopulation, but a living vaccine gives promise. A standard killed vaccine affords protection for a short period.

Feed Required for Egg Production

The following diseases of chickens are the only ones that all authorities agree can be successfully prevented by vaccination: fowl pox, infectious laryngotracheitis, infectious bronchitis, and avian pneumoencephalitis. All of these diseases are caused by filterable viruses, and live viruses (sometimes attenuated) are used in the vaccines for immunization of birds against these diseases. With the possible exception of spirochetosis and erysipelas, bacterial diseases of fowls do not respond to vaccination with bacterins now available to veterinarians. Pasteur's original method of vaccination against fowl cholera was to use an attenuated culture vaccine. Failure to obtain uniform attenuation of cultures caused the Pasteur method to fail when tried under field conditions. Research work on vaccines, bacterins and other immunizing agents should be encouraged by the increasing number of diseases that can be successfully prevented by immunization procedures.

Packers Relieved of Cost of Federal Meat Inspection

Beginning July 1, 1948, the cost of Federal Meat Inspection will again be financed by the Government through appropriations of $11,500,000 included in the USDA appropriations bill just passed by Congress and signed by the President June 21st.

California Meat Inspection

State meat inspection in California completed the 30th year of operation in 1947. At year's end state meat inspectors numbered 103 and 238 establishments were operating under state meat inspection.

The inspected slaughter during the year totaled 6,288,076 animals, of which 207,103 received approved municipal inspection, 939,869 state inspection and 5,141,104 federal inspection.

The whole carcasses condemned numbered 214 (0.1%) on municipal inspection; 3,873 (0.4%) on state inspection and 27,785 (0.54%) in plants having federal inspection.

The number of animals slaughtered without inspection was estimated at probably 247,000. This comprised animals slaughtered on farms, animals slaughtered in counties having a population of less than 28,000 where state meat inspection is not compulsory and animals inspected in establishments which were granted exemption from inspection.

Livestock Production in Los Angeles County, California

Dr. L. M. Hurt, Livestock Inspector of Los Angeles County, gives the following estimates of livestock production for 1947:

Horses $3,231,600 (includes 1200 thoroughbred colts at $1500 each)

Cattle $66,878,389 (includes $61,200,452 worth of dairy products)

Sheep $565,006 (includes $93,562 for wool)

Goats $1,917,400 (includes $1,827,000 for milk)

Swine $3,685,240

Fur animals $636,790 ($404,500 for chinchillas)

Chickens $35,104,500 (includes $24,500,000 for eggs)

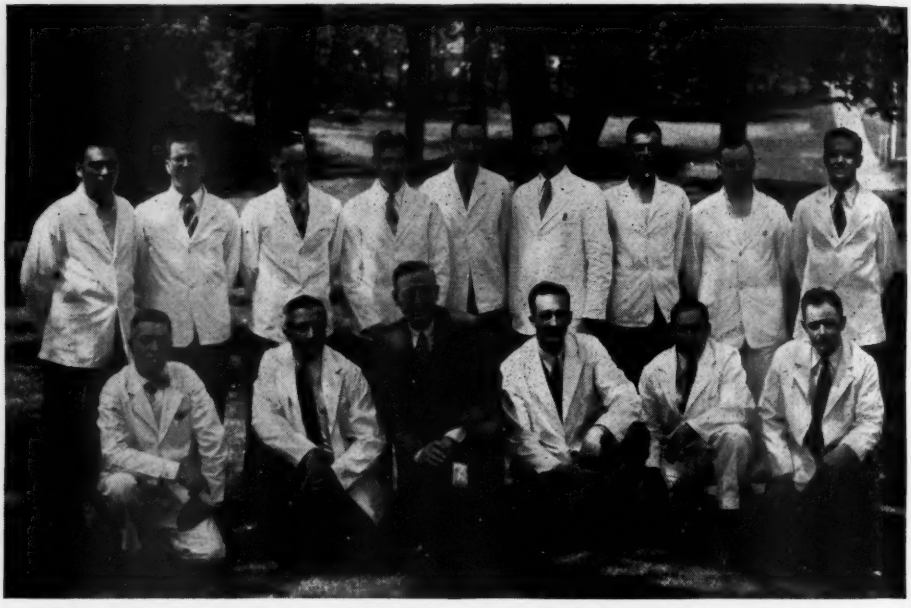
Turkeys $2,433,000 (includes $138,000 for hatching eggs)

Ducks $147,550

Rabbits $6,423,100 (including $512,500 for pelts)

When $1,926,966 is added to the foregoing as the value of the fertilizer supplied by the livestock it gives a grand total of approximately $122 million for the year.

The Veterinary School, University of Minnesota



Front row, left to right: H. C. H. Kernkamp, Reuel Fenstermacher, W. L. Boyd, Martin H. Roepke, H. L. Bachrack, Jay H. Sautter; back row: F. A. Spurrell, Ralph Kitchell, B. S. Pomeroy, Harvey H. Hoyt, Alvin F. Sellers, W. J. Hadlow, G. H. Conner, Winston Malmquist, James Williams

In 1947, the state legislature of Minnesota appropriated one million dollars to expand the work in veterinary science at the state university into a full school program. The Board of regents thereupon created a School of Veterinary Medicine within the college of Agriculture Forestry and Home Economics. The beginning of the following school year, September 1947, was set for the opening of the new school.

The task of assembling a faculty, developing a curriculum, organizing a school and procuring equipment almost during a summer vacation seemed a formidable one indeed. to the Director and other faculty members of the Division of Veterinary Science. But it was somehow accomplished and the new school got away to a creditable start on schedule, with a class of 24 first year students, in September 1947.

The faculty of the new school comprises: Director, Willard L. Boyd; professors, Howard C. H. Kernkamp and Martin H. Roepke; associate professors, Reuel Fenstermacher and Benjamin S. Pomeroy; instructors, G. H. Connor, Ralph Kitchell, Jay H. Sautter and Alvin F. Sellers, W. J. Hadlow, Harvey H. Hoyt, H. L. Bachrach, Winston A. Malmquist, F. A. Spurrell and James E. Williams. With the beginning of the next school year additinal faculty members and laboratory and clinical facilities will be required. In the building plans priority is held by the clinical building.

A temporary three-story building of the army barracks type was erected during the year. This building, which is 170 feet long and approximately 40 feet wide, provides a goodly number of laboratories, class rooms, and offices needed for presenting the subjects of physiology, pharmacology, pathology, bacteriology, and parasitology.

The architect's plans for the construction of the clinical building are completed and ground has been broken for this building. Several new faculty members have been added, which during the days of the housing difficulty is quite an accomplishment. The program will require each instructor to engage in research. The number of freshmen that will be accepted with the beginning of the 1948-49 college year is as yet undecided. If conditions work out satisfactorily it is expected that a larger class than was admitted in the fall of 1947 will be accepted.

A patent has been issued on the process of incorporating radioactive materials in glass.

New Local Anesthetic

That radioactive bromine is used in preparing a new local anesthetic, dibromo procaine, has been reported in *The British Medical Journal.*

Detection of Brain Tumors

The use of radioactive dye for the detection of brain tumors is reported from the University of Minnesota Medical School. The dye used was flourescein, which is known to have an affinity for tumor tissue. To this dye is added radioactive iodine and when injected into veins it becomes concentrated in the abnormal tissues of the brain and can be detected with a Geiger-Muller counter.

More Comfort for Leucemia Patients

It is said that complete body irradiation with radioactive phosphorus P^{32}, can prolong and make comfortable the life of patients with chronic leucemia. However, there is a wide difference in response and in the requirements of amount of radiation in individual patients. Large enough amounts of radiation to have a permanent effect upon the disease, cannot be given safely so palliation is the objective at present.—*J. Am. Med. Assn.,* 1948.

Radioactive Cobalt for Neoplasms

A preliminary report on the use of radioactive cobalt needles, in the treatment of radiosensitive neoplasms, has been made by the Medical Department of the Ohio State University. After eight years intensive study, entailing applications of radioisotopes and two years of experimentation upon animals with the radioactive cobalt needles which emit gamma radiation, it is believed they will prove useful in the treatment of such neoplasms in man as at present are being treated by radium.

The needles are 3cm in length and 1mm in diameter and are malleable so they can be bent to fit lesions such as tumors in bone, and there is no danger of leaks or breakage. Although called cobalt needles they contain an alloy of cobalt and nickel designated Co^{60}. In order to eliminate the soft beta radiation present and thus minimize periacicular necrosis where only the effects of the gamma radiation is desired, the needles are enclosed in a thin, strong, inexpensive casing of stainless steel or Monel metal. Soon after irradiation of the needles in the atomic pile at Oak Ridge, the gamma radiation of each is equivalent to that of 4.08mg of radium.

Radioactive cobalt is the material that the chairman of the Atomic Energy Committee stated to President Truman could become an inexpensive and plentiful substitute for costly radium now used in cancer treatment. The dosage cost of radioactive cobalt at present prices (May, 1948) is about one-tenth that of radium.

In addition to the Ohio State University, the Memorial Hospital in New York, the University of California and Washington University in St Louis, are making tests and studies of radioactive cobalt.

In commenting upon this isotope Dr. Leonard Scheele, formerly director of the National Cancer Research Council and the newly appointed Surgeon General of the U.S. Public Health Service, has said: "If radioactive cobalt proves to be an entirely effective substitute for radium in the treatment of cancer patients, and we have reason to believe this will be so, it will afford welcome relief to hospitals and medical centers throughout the country."

Protect Your Cement

Sometimes it is necessary to protect cement surfaces against acids for a drop of acid here and there weakens the area to that extent and causes the smooth surface to become rough and pitted. Such a surface is difficult to work on and is hard on the feet. Also it presents a cleaning problem. It is a well known fact too, that it is hard to keep a cement floor well covered with paint and bare spots present a good place for acids spilled to do their eating away. Consequently it is well to be prepared to meet these problems as they arise, or better still, before they arise, and this is one way to do it with little effort, skill and small cost.

Take some pure asbestos very finely powdered, the amount to be used will depend on the area of cement you want to cover. Take a thick solution of sodium silicate which must be as alkaline as possible. Rub the asbestos with the sodium silicate until a thick cake is formed then place in a container that can be tightly closed. When ready to apply the proofing, simply take the cake and thin it with sodium silicate and paint it on in two or three coats allowing twenty-four hours between applications. Sodium silicate alone will give protection to all cement surfaces, but it wears away faster and does not have the body to it that the addition of asbestos powder gives. No benefit will be derived from this paint unless all surfaces are clean and dry. Do not attempt to use it over paint.—*L. R. Palmer.*

Retirement of Army Veterinary Corps Officers

Announcement is made that Colonel Floyd C. Sager, V.C., 54, was retired for physical disability, effective 31 May, 1948. Colonel Sager was born in Barton, N. Y., and graduated from Cornell University with the degree of Doctor of Veterinary Medicine in June 1917. He was also a graduate of the Army Veterinary School, the Medical Field Service School, and attended a special course of instruction in the science of breeding and clinics at the University of Kentucky.

Colonel Sager was commissioned a 2d lieutenant in the Veterinary Corps on July 16, 1917, and has been promoted through the grades to colonel August 3, 1943.

During World War I Colonel Sager was attached to the 15th Field Artillery, 2d Division, and served with the A.E.F. from January 1918 to August 1919, being awarded the Silver Star with three oak leaf clusters.

Since 1919 Colonel Sager has served in various important station assignments in the United States, his principle duties being remount and Breeding Service activities. After a tour of duty in the Philippines in 1938 he was assigned to the Robinson Quartermaster Depot (Remount), Fort Robinson, Nebraska, and at the time of his retirement was Depot Veterinarian at the Aleshire Quartermaster Depot (Remount), Front Royal, Virginia.

Having reached the statutory age for retirement, Colonel Frank C. Hershberger, V.C., 64, was retired effective 31 May, 1948. Colonel Hershberger was born in Fountain, Indiana, and attended the University of Missouri, and was graduated from Kansas City Veterinary College in June, 1913, with the Degree of Doctor of Veterinary Medicine. He is also a graduate of the Medical Field Service School, the Army Veterinary School, and the Cavalry School, troop officers' course.

Colonel Hershberger was commissioned a 2d lieutenant, ORC, July 27, 1918, and ordered to active duty on August 1, going overseas in September of that year. Upon his return from overseas he was assigned to Camp Upton, N. Y. On September 16, 1920, he was discharged as major and accepted a commission as 1st lieutenant in the Veterinary Corps, Regular Army. He has been promoted through the grades, attaining his colonelcy on September 10, 1943.

In addition to serving as Transport Veterinarian, USAT Meigs from June 1928 to October 1929, and Department Veterinarian, Philippine Department from March 1935 to July 1937, Colonel Hershberger was Port Veterinarian, New York Port of Embarkation from March 1938 to June 1946, when he was assigned to the Caribbean Denfense Command with station in Panama as Department Veterinarian. At the time of his retirement he was serving as Station Veterinarian at Camp Hood, Texas.

Colonel Hershberger was awarded the Legion of Merit in 1946 for outstanding service performed at the New York Port of Embarkation.

* * * *

The idea that troops can be acclimatized to go without water in the desert is shown both in theory and in practice to be entirely fallacious.—*Physiology of Man in the Desert.*

* * * *

Veterinarians meeting here say the hoof-and-mouth disease is being conquered. Except among hitch hikers and politicians.—*Cincinnati Enquirer,* Aug. 21, 1947.

* * * *

Veterinarians Ordered to Active Duty in the Army

Dr. Thurman S. Grafton, Lansing, Michigan, has been commissioned a 2d Lieutenant, Veterinary Corps Reserve, and upon his own request called to active duty and assigned to the Army Medical Center, Washington, D. C., for duty with the Veterinary Division, Army Medical Department Research and Graduate School.

Dr. William E. Davenport, Decatur, Texas, has been commissioned a 2d Lieutenant, Veterinary Corps Reserve, and upon his own request called to active duty and assigned to Fort Sill, Oklahoma, with temporary duty 12 weeks at Chicago, Illinois, for the purpose of pursuing the meat and dairy hygiene course.

Major Richard M. Zirkle, V.C., has been recalled to active duty and assigned to the Reno Quartermaster Depot (Remount), Fort Reno, Okla. Prior to his separation Major Zirkle served at remount stations and overseas.

Captain Herman Tax, V.C., has been recalled to active duty and assigned to the 1300 ASU, New York Port of Embarkation, Brooklyn, N. Y. Previously Captain Tax served at stations within the First Army from July 1942 to June 1946.

Lt. Colonel Frank A. Todd, V.C., who has returned from the European Command where he has been on duty with the Veterinary Section, Public Health Branch, Internal Affairs and Communications Division, Office of Military Government for Germany, U. S., has been assigned to Headquarters Military District of Washington, The Pentagon.

Enterotoxemia of Sheep*

(Pulpy Kidney Disease)

Enterotoxemia of sheep is an acute intoxication resulting from the elaboration of toxin by *Clostridium perfringens* (*Cl. welchii*), Type D, in the digestive tract of sheep. The disease has been commonly referred to as pulpy kidney disease, feed lot disease, and overeating.

Young lambs nursing heavy milking ewes, older lambs on luxuriant pastures, and feed lot lambs on heavy grain rations are those most generally affected. Symptoms vary but the most frequently observed are diarrhea, listlessness, incoordination, dyspnea, convulsions and coma. Death generally occurs within a few minutes to four hours after onset of symptoms. Many animals die before sickness is observed. Mortality of affected lambs is nearly 100% and flock loss of 30% or more is not uncommon.

Entertoxemia is often mistaken for hemorrhagic septicemia.

Lesions include congested and swollen kidneys with easily removable capsule. If autopsy is delayed one to three hours the kidneys are found soft and pulpy—hence the name, pulpy kidney disease. Moderate congestion to areas of acute inflammation and hemorrhage are found in both small and large bowel. Mesenteric blood vessels are engorged. The pericardial sac contains an excess of straw colored fluid which may clot. Endocardial and pericardial hemorrhages are common.

Because of the suddenness of death, enterotoxemia is frequently attributed to plant or chemical poisoning, or, on autopsy, confused with hemorrhagic septicemia.

*From an announcement by the Corn States Serum Company, introducing Clostridium perfringens (type D) bacterin.

Bacteriology

At least four classes of *Cl. perfringens*, types A, B. C and D, have been recognized. According to investigations in Australia, New Zealand, and this country, Type D predominates and is responsible for the majority of losses due to enterotoxemia. It is frequently found in soils and sequentially in the digestive tract of normal sheep, where, under varying circumstances, it becomes capable of elaborating a highly lethal toxin. As little as 5cc of toxin is sufficient to kill sheep and .0005cc will kill mice.

Control of Enterotoxemia

Formalized culture (bacterin containing a high content of toxoid) has been proved effective as an aid in prevention of enterotoxemia. In Australia, where the condition occurs in lambs two to three months of age, death loss was reduced approximately 80%. In New Zealand, the death loss of lambs during the first six weeks of life was greatly reduced through the passive immunity obtained from the colostrum of mothers which had been immunized with two doses of formalized culture prior to parturition. An appreciable antitoxic blood titer and satisfactory degree of protection was demonstrated in such lambs for a period longer than a month after birth. However, direct injection of lambs at three to 10 days of age failed to afford protection.

In this country, Muth, of Oregon, demonstrated the effectiveness of alum-precipitated toxoid in controlled field trials and also in stimulating the production of antitoxin in lambs. He showed that 18 days following the administration of two doses, 5cc each, of toxoid, all of a group of six lambs showed systemic antitoxin and, using one dose, five of six lambs showed systemic antitoxin—an indication of the increased value of two doses.

DDT May Extend Man's Horizons

Insects and related invertebrates long have been man's chief competitor for the world's supply of food. They have been so successful as to make man's subsistence a more or less precarious struggle in most thickly settled regions and to render vast areas uninhabitable or inhabitable only at the price of health. Examples are mosquito infested jungles of the Western Hemisphere and vast regions of Africa where the "tse tse" of the tsetse fly warns away would-be intruders.

Dr. P. J. du Toit, Director of Veterinary Services for South Africa, recently reported some experiments in combatting tsetse flies with DDT, which were conducted under his supervision. A 100-square-mile area was

sprayed with DDT from airplanes and broken areas such as gulches also from the ground with aersol bombs. With six planes he was able to spray 50 acres a minute at a cost of 60 cents per acre. The area was sprayed six times at monthly intervals. The tsetse flies were almost but not quite eradicated. As the insect reproduces slowly hope is entertained that other measures will complete the destruction of the insects and demonstrate the feasibility of opening a vast area of Africa for settlement and food production by abolishing the pest that inflicts sleeping sickness on man and fatal trypanosomiasis on his animals.

Parasite Penalties

Experiments have shown that young pigs exposed to an assortment of internal parasites gained only one-third as much weight as their protected litter mates. Pigs with moderate infestation took nearly a pound of feed more for each pound of gain than did protected pigs, and required five weeks longer to reach market weight. Sheep infested with parasites lost nearly a pound a week for 17 weeks while uninfested lambs gained 2.4 pounds weekly. Fairly well protected fattening steers gained weight 10 to 30% faster than those not protected, and gave three to six times more dollar return on the investment.—*USDA.*

Disregarding the gestation period, when her dam was probably producing milk, the dairy heifer requires two years to grow, two more years to pay for the cost of raising. During the next two years she should produce a profit and that is the average age at which dairy cows are discarded; just two years profit from six years care. However, if properly fed and cared for she should return a profit for another six years. Thus at eight years of age she would have doubled the profit at six years; at 10 years of age tripled it and at 12 years returned to her owner as much net profit as four average cows.

Cauterization Becomes Chemosurgery

Frederic Mohs, M.D., Madison, Wisconsin, has invented a new name for an old veterinary treatment of excessive granulations following wire cuts and other wounds on the legs of horses, bursattee etc. The new name is "chemosurgery." The technic is described in *Newsweek* as follows:

"First, the cancer is fixed in position by painting the surface with a zinc chloride paste, which temporarily prevents the cancerous cells from spreading. The next day, one layer of the growth is removed and more fixative applied, and the operation is repeated until, through microscopic examination, an entirely cancer-free layer of tissue is reached."

The Madison physician has treated several hundred cases of carcinoma of the face (lips, nose, cheek and ear, in fact, any easily accessible cancer) by chemosurgery with entire satisfaction.

Worming a lightly infected, healthy dog which will continue to be exposed to hookworm infection is, in my opinion, completely futile.—*G. F. Otto.*

Swine Erysipelas Infections in Man

McIntyre writing in the *British Medical Journal* expresses the opinion that infections of persons by *Erysipelothrix rhusiopathiae* occurs more frequently than is commonly supposed, *i. e.* that cases are frequently incorrectly diagnosed. The cases he mentions were cutaneous infections due to scratches from a bone or cuts from a butcher's knife and occurred in butchers, gamekeepers, cooks, farmers who have been skinning sheep, and housewives. The infections occur chiefly from August to February, begin with a purple patch, usually on a finger and in most instances the victims recover spontaneously in three weeks. In this country erysipeloid appears to occur more frequently among veterinarians than among the personnel of other occupations.

Long Life for a Pharmacy Text

There have been many instances of literary masterpieces that dominated their field for long periods, but such occurrences are usually thought of as being productions of the distant past such as Galen's works that ruled medicine for 1300 years or Shakespeare's plays or the Bible. In this age of mass production of books and rapid change in college texts Morrison's feeds and Sisson's anatomy are already hoary compared to their contemporaries.

The publication of the 9th edition of Remington's Practice of Pharmacy has just been announced. For 63 years this work has been the outstanding authority on the science and art of pharmacy.

The original text possessed the quality of masterfulness. It has been retained in succeeding revisions to keep in the forefront of pharmacy and medicine. Dr. Joseph P. Remington, the original author, probably envisioned a long period of usefulness for his work, for he assigned the copyright to his alma mater, the Philadelphia College of Pharmacy and Science, thus enlisting a permanency unaffected by obituary columns or mortality tables.

Alibis for Foot-and-Mouth Disease Reports

At the congressional hearing, on the foot-and-mouth eradication project in Mexico, questions arose as to the responsibility for the optimistic reports of progress, which were issued without factual basis. Of them, Gen. Charles H. Corlett, special representative of the Secretary of Agriculture, said "I know the feeling of the men from having worked with them, and I do not think they intentionally held back any information from anyone." Presumably, being very busy they just forgot to mention it.

Mr. A. K. Mitchell, Chairman Advisory Committee on foot-and-mouth disease paid tribute to the interest and determination of

Udder lesions of foot-and-mouth disease in a Mexican cow

the United States personnel "even when the situation looked almost hopeless. They did not want to break down the morale of the Mexican people and thereby destroy any last hope of victory. In view of this, the [baseless] encouraging press information given out about the progress of the work was justified."

Two things wrong with this alibi are: (1) the morale of the Mexican people was in no danger of a "break down." Unfortunately their high morale bolstered the wrong side. (2) The Mexican people and the Mexican government were fully informed as to the futility of the operations and couldn't have been hoodwinked, even if they had received and read "the encouraging press information given out about the progress of the work."

Mr. Mitchell further stated: "I do not feel that any information has been withheld from Congress or any other group that should have had it." As to the Congress, Congressman Gillie, chairman of the subcommittee on foot-and-mouth disease, thought otherwise and has asked for the appointment of a liason agent to supply Congress with accurate inofrmation. As for "any other group," Mitchell in his testimony gave no indication of competence to decide the matter.

Dr. Stewart H. Madin, TEX'43, of the University of California, has joined the three BAI veterinarians—L. O. Mott, H. W. Johnson, and E. A. Eichhorn—who proceeded to Europe about three months ago to study the manufacture of foot-and-mouth disease vaccine.

It is extremely significant that in those countries which have no bovine tuberculosis control program, the incidence of infection among cattle remains very high, and there is a relatively high incidence of bovine type infection among humans. The gains made in this country in controlling bovine tuberculosis can be maintained and advanced only by exercising constant vigilance. As long as a single tuberculous animal remains, the possibility of the transmission of the infection to healthy animals and to humans exists. The goal must be complete elimination of the disease.—KARL H. PFUETZE, M.D.

Motion Picture Films for Veterinary Meetings

The U. S. Public Health Service, Communicable Disease Center has four new films of interest to veterinarians which are available on loan to veterinary meetings and veterinary colleges. The titles are:

1. Fight Against Rabies—running time, 14 minutes.
2. Laboratory Diagnosis of Rabies—running time, 8 minutes.
3. Spread and Prevention of Trichinosis—running time, 12 minutes.
4. Worms in Your Muscles—running time, 10 minutes.

All films have sound tracks, all are black and white and all are available on loan for 30 days (indefinite loan to veterinary colleges). There is no charge for the film but borrowers are required to pay the return postage. Inquiries should be addressed to:

Medical Director in Charge, Communicable Disease Center, 605 Volunteer Building, Atlanta 3, Georgia, and marked: Attention, Film Library.

An Aid in Anesthesia

Dogs fed 150gm of sufanilamide per kilogram of body weight for five days prior to being subjected to chloroform anesthesia for one hour, showed[1] less necrosis of the liver than did control dogs, and there was no depression or vomiting such as occurred in the controls, five of eight of which died from the prolonged chloroform anesthesia.

When given during the anesthesia sulfanilamide has not been beneficial. The protective action of the drug during anesthesia is thought to be due to the depressant effect upon the thyroid gland.

Study Hemophilic Puppies

Research workers at Cornell University report a study of 17 hemophilic puppies, all of the same ancestry. Although hemophilia is believed to be extremely rare in dogs (because in nearly all instances it is lethal in early life) it sometimes occurs and is sex-linked as in man. In the puppies studied fatal hemorrhage could be started by the slightest accidents; tumbling in play, picking up by the owner, slight scratches, in one instance erupting a tooth. Despite the best of care all 17 puppies died before reaching the age of seven months.

Eradication of Rabies Is Past Due

Of the one-half million persons in the United States bitten by dogs each year only 30 to 70 die of rabies. Those who oppose the eradication of the disease, or the adoption of measures necessary for its eradication, which is the same thing, cite these small numbers of fatalities as proof that in this country rabies is a minor public health problem.

However, rabies is not a minor problem to its victims or their relatives, nor is it lightly accepted by the 30,000 to 50,000 who annually take antirabies treatment. Deaths from rabies, be they few or many, are unnecessary deaths, and the apprehension, foreboding and often acute distress, occasioned in the families of those who feel they must take the prophylactic treatment, is a serious matter.

No other disease of domestic animals in this country can be eradicated with so little effort as would be required to eliminate rabies. It is not communicated through the air, by insect vectors, by articles in contact with the affected animal nor even by contact with the affected animal, except the victim be wounded. Significantly, it is communicated only by the bite of a rabid animal and, with few exceptions, only by bite of a single animal—the dog. The channel of communication is a tenuous one, easily broken. It has been shown repeatedly in outbreaks in this country that the disease disappears from a locality when 60% or more of the dogs are vaccinated. Effectual confinement or muzzling (if that be possible) of an equal percentage would no doubt have the same effect. However, diseases should not be fought by a single method, but by all effectual means.

This amazingly prosperous country can afford many luxuries, but rabies is not one of them.

Rabid Foxes

A fight against rabid foxes has been started by the Florida State Board of Health, Florida Fresh Water and Fish Commission and the State Livestock Sanitary Board. S. M. Canup of the U. S. Fish and Wildlife Service is in Florida to supervise the work. The situation has become so acute that rabid foxes on several occasions have come into towns and attacked dogs, cattle and in some instances human beings.—*J. Am. Med. Assn.*

Rabies Statistics for 1947

Cases of rabies reported to the Bureau of Animal Industry from all the states totaled 8,946 in the calendar year 1947. This is a reduction of 1926 cases, 18%, from the record number of 10,872 cases reported for 1946. It is realized reporting is incomplete for farm animals and even for dogs (no cases were reported from 14 states and only one case from each of two other states) and must be far from comprehensive for foxes and other wild animals, however the reporting may be assumed to be proportionate for the two years and thus indicates a material decrease in the incidence of the disease last year.

Cases reported in persons numbered 26, an increase over last year of 4. The cases reported in dogs numbered 6,949; in cattle, 766; in horses, 40; in sheep, 15; in swine, 20; in goats, 9; in cats, 393, and in foxes and other wild animals, 728.

Texas lead all other states in the number of cases with 1,191 reported, Tennessee was next with 864, New York third with 744. The remaining states reporting more than 300 cases are: Louisiana, 614; Ohio, 591; Alabama, 475; Georgia, 471; North Carolina, 459; Indiana, 383; Michigan, 339; California, 305, and Pennsylvania, 304. Thus one-fourth of the states reported three-fourths of the cases.

1 Tanturi et al, Surg. Gynec. Obst. 84:477.

Infectious Equine Encephalomyelitis in 1947

A total of 8,716 cases of infectious equine encephalomyelitis were reported to the federal Bureau of Animal Industry from 33 states

during 1947. This is more than three times as many cases (2,805) as were reported during the preceding year. The increased prevalence was due largely to the outbreak in Louisiana in which 3,813 cases occurred. The cases in the states other than Louisiana numbered 4,903.

The case mortality (58%) was much higher in 1947 than in any preceding year. This too was a reflection of the Louisiana outbreak where the Eastern type of the disease prevailed and the mortality was 90%. In states where the Western type of encephalomyelitis prevailed the usual mortality of 15 to 30% was experienced, but cases occurring in the Middle Atlantic, South Atlantic and Gulf Coast states where the eastern virus is indiginous raised the average mortality for all states other than Louisiana to 33%. From the record it is not readily apparent why the mortality should have been 92% in Virginia, 93% in North Carolina and only 15% in South Carolina.

Except for Louisiana the states in which the largest numbers of cases occurred were: Texas, 715; Iowa, 583; Nebraska, 453; Minnesota, 345; Oklahoma, 342; Kansas, 308; California, 283, and Illinois, 224. The largest death losses were: in Louisiana 3,450 animals; in Texas 563, and in Iowa 156.

The number of cases of equine encephalomyelitis reported to the Bureau for each of the past 15 years is as follows:

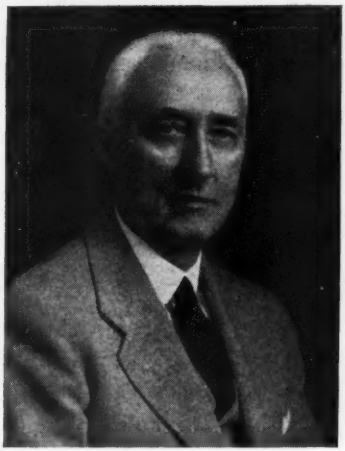
1935.....	23,512	1942.....	4,939
1936.....	3,929	1943.....	4,768
1937.....	173,889	1944.....	19,590
1938.....	184,662	1945.....	3,212
1939.....	9,800	1946.....	2,805
1940.....	16,941	1947.....	8,716
1941.....	36,872		

The Bureau estimates that 340,000 animals were vaccinated for the prevention of encephalomyelitis; of these 22 were reported to have contracted the disease and eight died.

D. W. Amarasinghe, veterinary officer in Ceylon and in the U. S. on study leave, reports that strains of pneumoencephalitis virus of low virulence are encountered in the island, as well as the extremely virulent strain of the virus commonly seen in Europe and Asia. He states the disease caused by the former may be easily confused with infectious bronchitis, laryngotracheitis, coryza, etc.

New Veterinary Dean at K. S. C.

Dean R. R. Dykstra retired as head of the School of Veterinary Medicine, Kansas State College, July 1, after more than 31 years in that position—29 years as dean and two years as acting head of the school. He will continue



R. R. Dykstra

with the school as dean emeritus and professor of surgery.

Dean Dykstra was graduated from the Veterinary Division of Iowa State College in 1905 and served on the faculty of that school six years, going to Kansas 37 years ago as assistant Professor of Veterinary Surgery. When he became head of the school the enrollment was but 40 and the faculty numbered four; now the enrollment is 240 and there are 23 members of the faculty. Degrees have been conferred upon 1,135 students during Dykstra's regime. Progress in building facilities for the school has been even greater than in building enrollment and faculty. A veterinary hospital, a clinic and an ambutory clinic and, even more outstanding, since it was assembled without public funds, a veterinary library of more than 4,000 volumes and containing all current veterinary periodicals has been acquired.

Dean Dykstra has long been active in local and national veterinary associations. He was

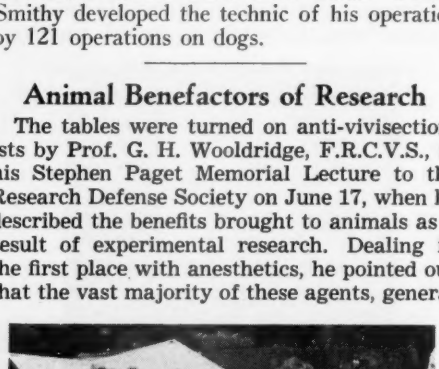
president of the Kansas V.M.A. in 1917, of the A.V.M.A. in 1932 and of the Association of Veterinary Deans as long as anyone can remember.

Contribution from Dogs

A heart crippled by rheumatic fever is one of the most serious affections of children and adolescents. The mortality has been among the highest of all ailments. A new operation for the relief of the condition has been developed by Dr. Horace Smithy of the Medical College, of South Carolina. It relieves some cases that heretofore would have been fatal. Doctor Smithy developed the technic of his operation by 121 operations on dogs.

Animal Benefactors of Research

The tables were turned on anti-vivisectionists by Prof. G. H. Wooldridge, F.R.C.V.S., in his Stephen Paget Memorial Lecture to the Research Defense Society on June 17, when he described the benefits brought to animals as a result of experimental research. Dealing in the first place with anesthetics, he pointed out that the vast majority of these agents, general



Anesthesia is used in experimentation

and local, were either discovered or perfected as a result of such research, and that this had meant that hundreds of thousands of essential operations annually performed on animals were now carried out without any pain or suffering whatever. All veterinary surgeons as a routine measure resorted to anesthetics on every possible occasion to prevent and relieve pain. Many suffering animals whose recovery was hopeless had been given the benefit of euthanasia by means of "nembutal."

The use of sulfonamides, again, had been established by experimental research, and such drugs had enabled thousands of animals suffering from pneumonia and other infections to be relieved and cured. It was conservatively estimated before the war that a quarter of the cows in milk were affected with mastitis, a disease in which sulfanilamide, given in the early stages, brought about favorable results in from 60 to 90% of cases. Penicillin also gives promise in the treatment of this condition, as well as in infections caused by *Staphylococcus aureus* in the udder. The disease known as redwater in cattle, caused by parasites invading and destroying the red corpuscles, formerly took an enormous toll of life in most tropical countries, but by the use of trypan blue, a discovery due to experiments on animals, this loss and attendant suffering had been reduced to insignificance. Another parasitic blood affection, known in South Africa as East Coast fever, had yielded to preventive inoculation. The same was true of rinderpest, or cattle plague. As a result of intensive experimental research an immunization technic had been perfected and cattle plague totally eradicated from South Africa, where at one time it had threatened to exterminate all the cattle. This was not merely an economic gain, for cattle plague was an extremely painful disease to the animals themselves owing to the local lesions produced.

Diagnosis and Control

Other diseases of cattle which had been controlled as the result of inoculation were anthrax and "black leg" or "black quarter," the latter due to a soil organism. It had also been demonstrated that vaccination of young heifers effectively prevented contagious abortion in cows. As for bovine tuberculosis, tuberculin had been shown by guinea-pig and cattle experiments to be a satisfactory diagnostic agent, and with its aid there was a good prospect that tuberculosis of cattle might ultimately be stamped out in this country. Among diseases of horses which had been largely controlled by experimental research Professor Wooldridge mentioned glanders and tetanus; among diseases of sheep, lamb dysentery and "swayback"; and of pigs, swine erysipelas and swine fever. In dogs and cats experimental work on nutrition had resulted in the reduction of the incidence of rickets almost to vanishing-point. Prophylaxis had enormously reduced the incidence of distemper, while rabies in this country had been exterminated simply because, as a result of experimental research, its cause and mode of transmision had been discovered.

Professor Wooldridge concluded by saying that it was abundantly clear that practically all species, at any rate of domesticated animals, had come to enjoy most remarkable benefits as a result of experimental research, and no veterinary surgeon could possibly do his duty to the animal world unless he took full advantage of the discoveries made by research workers.—*Brit. Med. J.*, No. 4516, 1947.

Adventures in Meat Inspection

By E. T. BAKER, D.V.M.
Moscow, Idaho

As Henry Wadsworth Longfellow once observed before the Democrats took over the country: "Into each life some rain must fall." This applies particularly to handling meat inspection in a small town. A heart-rending episode took place recently that makes us wonder how life can be so cruel.

A middle-aged childless wife had a little dog with the poetical name of "Pitty Sing," which she had raised from a little puppy. She had devoted three years' of untiring mother love and affection on the pooch, and further details are unnecessary to enumerate to anyone in our profession.

She had come from a large city, where she could procure fresh horse meat, and Pitty Sing would eat no other food. When offered tenderloin taken from the running gears of a prime steer, he turned up his royal nose. A piece of T-bone, and even calves' liver, were also disdained.

So, the bereaved canine owner came to me with tears in her big, brown eyes. Her lips quivered as she told me her butcher would not order fresh Percheron meat for her starving little doggie. He explained to her he could not handle horse meat in connection with food for humans.

She said the heartless butcher preferred carrying meat for people instead of devoting his establishment to the retailing of equine cutlets. She was amazed, she explained, at his callous attitude. Where was western chivalry, she wanted to know.

As gently as I could, I explained to her that, according to the regulations of the Department of Agriculture, John L. Lewis and the Twelve Apostles, markets could not handle bangtail hash and edible meats for people in the same establishment.

Then I asked if Pitty Sing could not assimilate breast of humming birds, or even domesticated rabbit? No, she said, he would starve first, and then she would be a bereaved woman the rest of her life, if she lived that long.

It was a tragic situation. What trivial problems the United Nations have to solve compared to ones like these?

As a last resort, if Pitty Sing starved to death, I could donate a couple daffodils, or a small twig from one of our evergreen trees, to the funeral. Also, I would ask the city attorney to act as an honoray pall bearer, but, just then, the tide turned.

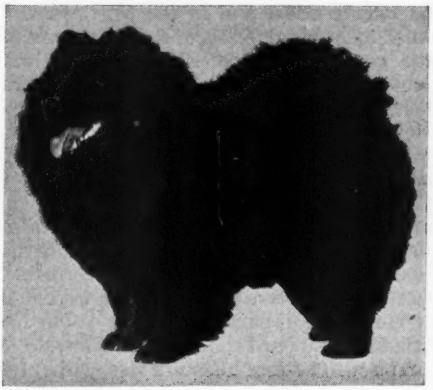
While we were talking, a farmer's wife came in and asked where she could buy a copy of my book on animal care. She wanted to give a copy of it to her nephew, who was a member of the 4-H Club.

After she had left, Pitty Sing's mistress smiled, and asked:

"Oh, have you written a book?"

One cannot conceal all the acts of a misguided past so I nodded my head.

"I wrote a book once myself," she coyly



confided. "It was a poem which I called 'Scarlet Leaves.' I had 50 copies printed."

Again I nodded my head, but weakly. She went on to say her poetic ecstacy was only secondary to that of her love for Pitty Sing. She explained that her husband was wrapped up in his work, and he did not share her feelings in these two great channels.

"Yes," I told her, "while I have never been a mother myself, I know what real suffering is." Many a time I have sluffed an easy spare in a bowling match, or have picked out the wrong slot machine. Then she was assured that I would look around and see what could be done to save the precious life of Pitty Sing.

In a day or so I found that a market in another state, not very far away, handled a little frozen horse meat for mink raisers. When I told her about this oasis in the desert of canine vitamins she broke all speed records getting over there.

She has insisted on giving me an autographed copy of her book in grateful remembrance, but, so far, I have dodged her. A long experience in observing slow-paying clients disappear out of sight has taught me the fundamentals of this art.

There are enough troubles to keep my solemn and serious mind busy without pondering the pathos of "Scarlet Leaves."

HORSE MEAT INSPECTION

By LUKE R. SINCLAIR
Duluth, Minnesota

IT is the purpose of this article to explain a few differences between the inspection of horses and of the other meat-producing animals and also to make some observations which may be of interest to other veterinarians now in meat inspection work.

The author, an inspector in the Meat Inspection Division of the B.A.I., at the time of writing had been inspecting horses for slaughter for approximately a year, both on the Pacific Coast and in the Northwest. The boned meat obtained from the California plant was coarsely ground, shipped to a nearby cannery, where it was mixed with a gravy, then canned and shipped to Europe for distribution, originally by the UNNRA and later by the U.S. Army. Incidentally, the author has eaten this canned meat and can say that it compares favorably with any stew meat served in restaurants. At the Minnesota plant there was a somewhat different picture as far as disposal of the meat was concerned. The best hind-quarters were mostly exported to Belgium, but in part sent to one of our larger Atlantic seaboard cities for domestic consumption. The fore-quarters were either boned out, or ground in a "hogger" with the bone in for animal food, or rendered for tallow and tankage. One plant in North Dakota has recently started pickling their meat for export, and others will likely follow this practice in the near future. Hearts, livers, cheeks, kidneys, and usually tongues were used for animal food.

Ante-mortem inspection revealed many fine young horses of draft type going for slaughter at 2½c to 3c per pound, live weight. In other words, the average farm horse today is probably worth between $45 and $50. It appears that the tractor is really replacing the horse in earnest. Perhaps some re-education of the farmers by our agricultural colleges is necessary to change this trend. It would be interesting to have Wayne Dinsmore's views on this subject.

The horses slaughtered in California were from the Pacific Northwest, except for a few wild horses from Nevada. Although small, these wild horses quite often appeared to have good breeding in them; some even possessing a typical Arabian head. The ancestry of many of these animals probably traced back to the horses brought over by the Spanish conquistadores. The horses killed in Minnesota were usually obtained from either Canada or from the Dakotas.

There are a few differences between slaughtering and inspection of horses and of cattle that may be of interest. In most abattoirs, horses are almost invariably killed by shooting, usually by a .22 long rifle bullet. The carcass is bled by the usual method of severing the jugulars at the entrance of the thorax. The mane is shorn at the California plant, and the hair saved for the divers uses to which horse hair is put. The tail is removed in its entirety without benefit of skinning. After the skinning of head, neck, legs, and sides as with cattle, the remainder of the still adherent hide is removed by mechanical force. At two of the abattoirs this was accomplished by wrapping a chain around the rump and tail, or leg, portions of the already skinned hide, hooking the chain(s) to the floor, and hoisting the carcass to a point well above the rails, thereby pulling the hide off the carcass. This proces usually left a goodly portion of the cutaneous trunci muscle on the hide. Our big packing house superintendents would probably shudder to see all of that good bologna fodder going to waste. At another plant the carcass is suspended in midair by all four feet; a hook anchored to the wall is placed behind the symphysis of the mandible; a chain is wrapped around the neck portion of the hide and pulled backward by means of a winch. Since a horse carcass, with the occasional exception of the hind-quarter, is usually destined for the boning table or hogger, no attempt is made to do an artistic job of splitting and shrouding. The carcass is split to one side of the bodies of the vertebrae, and the neck is sometimes not split at all, being left on one side or the other.

The supraspinous processes of six or seven of the thoracic vertebrae at the withers, including the supraspinous bursae, are removed with a saw or cleaver. It is surprising to see the number of healed and calcified lesions in this area. Since melanin deposits in white or grey horses have a predilection for the subscapular fossa, the fore-leg is partially removed in these animals by separating it from the ribs to reveal the area and allow removal of any melanin found there.

Washing a horse carcass is a long and tedious process. A memorandum on horse slaughtering states, "You will find that the hair nuisance is similar to that encountered when skinning a squirrel." The author has never skinned squirrels and does not wish to do so, if his experience with the skinning and wash-

ing of horses' carcasses is any criterion of what to expect. Horse hair and fascia seem to have a peculiar affinity for each other that is extremely difficult to overcome.

The inspection stamp used is of hexagonal shape and bears the legend "U.S. INSPD. & PSD., HORSE MEAT," with the establishment's number. Green ink is used, and green labels are applied to horse meat containers.

Turning to ante-mortem inspection, we find that most "suspects" are those afflicted with distemper or influenza. Very few cases of periodic ophthalmia were seen, and these were usually in well-fed saddle horses that appeared to be pets. Since Army veterinarians have shown this condition to be due to an avitaminosis, we can safely assume that these horses received too much grain and not enough good hay or pasture.

A newcomer to horse inspection will find that many of the lymph nodes are difficult to locate compared to those of cattle. A normal equine lymph node is about the size of the end of one's little finger; those of cattle are normally of the size of the end of one's thumb or larger. Although the bronchial nodes are fairly easy to locate, the mediastinal groups are practically non-existent as far as inspection is concerned. The pharynx is sometimes found to be inflamed and swollen, which condition is considered by some to be a manifestation of strangles.

At the California plant the head is split along the median line with a cleaver to facilitate examination of the nasal septum and sinuses for evidence of sinusitis, rhinitis, or glanders, the last being a disease which we younger men have never seen and hope never to see in this country.

At the Minnesota plant the anterior portions of the nasal bones are removed with a saw to reveal the nasal cavities and sinuses. The cheek muscles are not incised as with cattle. However, the hearts' chambers are exposed by incisions to determine the presence or absence of endocarditis, a condition often associated with influenza in horses.

The bile duct was incised with the remote possibility of finding flukes. The author has examined approximately 5,000 horses and has seen only one case of flukes, which were identified as adult *Fasciola hepatica.* Quite often the liver contains calcified nodules. Several of these nodules were sectioned and examined by Dr. C. L. Davis of the Denver B.A.I. Pathology Laboratory and the unidentifiable remains of a coiled nematode were found. Later, however, a specimen preserved well enough to be identified was shown to be *Setaria equina* by Dr. Benjamin Schwartz, Chief of the Zoological Division of the B.A.I. This cannot be considered as conclusive evidence that all of the nodules in horses' livers are the calcified remains of *Setaria equina,* however. But it does raise several interesting questions, e. g., what is the life cycle of *Setaria equina?* It was also quite common to find thread-like adhesions, "tags," on the opposing surfaces of the liver, diaphragm, and great colon. This condition could be due to the migration of some parasite, but this seems rather improbable when the fact is considered that approximately 99% of the livers examined had these tags in varying numbers and different locations on their surfaces. Several infectious diseases have been mentioned as the possible causes of these adhesions, but here again the high percentage of livers affected would seem to preclude this explanation. Their cause will have to remain a moot question for the present.

Most condemnations are for pneumonia, melanosis, strangles, and emaciation, and probably are in that order in numbers.

A comparatively rare internal parasite, the giant tapeworm, *Anoplocephala magna,* was seen several times. The thread-worm, *Setaria equina,* mentioned in a previous paragraph, seems to be a fairly common inhabitant of the peritoneal cavity of horses. Digressing the author is inclined to agree with Shope, that there are probably other diseases, than the three already known—blackhead in turkeys, salmon poisoning in dogs, and swine influenza —which can be transmitted by helminths.

In the above article the author has not disclosed any startling discoveries, and hopes he has not disappointed anyone by not doing so. However, he has attempted to reveal a little known phase of veterinary medicine, namely, the inspection of horses for slaughter.

A Liquid Germicidal Detergent in Veterinary Surgery[1]

By C. S. BRYAN, D.V.M., Ph.D., W. O. BRINKER, D.V.M., M.S., E. K. SALES, D.V.M., F. W. YOUNG, D.V.M., M.S., T. S. GRAFTON, D.V.M., and J. P. HUTTON, D.V.M.
East Lansing, Michigan

SOAP and water have long been used to cleanse the skin in the preparation of a surgical site. Where such cleansing has been followed by the application of a skin disinfectant satisfactory results have been obtained. Since there are many limitations to soap and water and some situations in veterinary practice where these are not readily applied, a continuous search has been made for a liquid germicidal detergent. Such a product should possess a marked ability to cleanse and at the time should be germicidal for the wide variety of organisms commonly encountered on the skin. This report deals with such a product.

Liquid Germicidal Detergent[2]

The liquid germicidal detergent used in this study was a suspension of high molecular weight alkylamide hydrochlorides containing 25% of a quaternary ammonium chloride compound (phemerol). It is characterized by wetting, emulsifying and germicidal properties, and mixes freely with water of any temperature and hardness. Since it is a cationic germicidal agent it should not be used with, or followed by, soap. The product was either used full strength or in a one to five dilution with water, except in the udder disinfection where a solution of one ounce per gallon of water was used. It was usually applied with a gauze pledget or cotton.

Methods

A swab technic was used to make comparative measurements of the organisms on the skin even though it is recognized that the results were not an absolute measure of the total number of organisms present. A swab was placed in 10cc of distilled water and sterilized by antoclaving. A small metal rod holding the cotton swab was attached to the inside of the bakelite cover of the small bottle. In some instances, as indicated in the paper, neutralizing substances were placed in the water to inactivate any germicide removed during the swabbing. This was necessary to prevent any further action of the germicide after the swab was taken. A skin area of 2x2 inches was swabbed in each experiment.

The samples were refrigerated until plated in dextrose tryptose agar. The blood agar used was prepared by aseptically adding 5% of bovine blood to dextrose tryptose agar. In some cases the plating was done within five minutes and in all cases it was completed within 30 minutes; no significant difference was noted when the plates were prepared at these times. All plates were incubated at 37°C. for 48 hours. A comparative study of the germicidal action of several common skin disinfectants was also made. Small areas were clipped and each prepared with a given product. A local anesthetic was then administered. Skin incisions were made using sterile instruments. A slice of tissue, one-eighth inch wide and 0.5 inch long was excised along the margin of the wound. This was transferred to a 10cc tube of dextrose tryptose broth. The tubes were incubated at 37°C. for 48 hours.

In the field studies of udder cleansing and disinfection a solution of the liquid germicidal detergent was prepared by adding one ounce per gallon of water. The same cloth was used on all udders. It remained in the solution for about one minute, while a milk sample was collected for test, before being used on the succeeding cow. The milk samples were tested bacteriologically.

Results and Discussion

The comparative effect of various germicidal agents and procedures on the bacteria count was determined. A measured area of 2x2 inches was treated, then swabbed for bacteriological study. It is recognized that this technic does not measure the absolute number of organisms present because the living bacteria that are in the hair follicles may not be reached. This examination, however, does allow the accumulation of data relative to the comparative counts following different treatments. The results from dogs, horses and cows were similar on repeated trials. Therefore, data of one species of animal only are given.

The value of using the undiluted or diluted liquid germicidal detergent for skin disinfection is evident from the data in Table I. After scrubbing the area for one minute it was thoroughly washed with sterile water to re-

1 Journal article No. 962 (N.S.) from the Michigan Agricultural Experiment Station, Section of Surgery and Medicine, East Lansing.
2 The Liquid germicidal detergent was supplied by the Parke, Davis and Co., Detroit, Michigan.

move the germicidal agent so that the germicide removed by the swab would not exert any action prior to plating. In addition the plates were poured within a period of five minutes after sampling. Clipping of the hair made it much easier to apply the detergent and also to take the swab sampling. We found a reduction in count from 160,000 and 180,000 prior to the use of the liquid germicidal detergent to from 30 to 90—with a total disappearance of hemolytic bacteria. This is evidence of the effectivenes of the agent whether used undiluted or diluted one to five with water.

TABLE I.—THE INFLUENCE OF VARIOUS PROCEDURES AND TREATMENTS ON THE BACTERIA COUNT OBTAINED BY SWABBING A 2x2-INCH AREA OF SKIN OF THE HORSE. STERILE WATER WAS USED TO REMOVE ALL DETERGENT BEFORE TAKING THE SWABS. THE SAMPLES WERE PLATED WITHIN FIVE MINUTES.

Skin area	Procedure	Treatment	Bacteria count	Blood agar	
				% Hemolytic	% non-hemolytic
1	Hair unclipped	none	180,000	70	30
2	" "	Scrubbed 1 min. with L.G.D*	60	0	100
3	" "	" " " " 1 to 5 dilution of L.G.D.	90	0	100
4	" clipped	none	160,000	75	25
5	" "	Scrubbed 1 min. with L.G.D.	30	0	100
6	" "	" 1 min. " 1 to 5 L.G.D.	40	0	100

* Liquid germicidal detergent.

tion of lauryl sulfate was used as the swab dilution agent to neutralize any liquid germicidal detergent transferred during swabbing.

An experiment was performed to determine whether light or heavy pressure on the swab and swabbing in one or both directions had any influence on the bacteria count. The results obtained, Table II, indicate that these factors exerted no influence so long as an approximate 2x2-inch area was covered. The bacteria count reductions and the destruction of hemolytic organisms obtained upon the use of the liquid germicidal detergent again indicate the value of the product in this respect.

TABLE II.—THE BACTERIA COUNTS OBTAINED WITH LIGHT AND HEAVY PRESSURE AND BY SWABBING IN ONE AND TWO DIRETIONS, AFTER CLIPPING THE HAIR OF THE HORSE, WHERE NO CLEANSER OR GERMICIDE WAS USED AND AFTER THE USE OF LIQUID GERMICIDAL DETERGENT.

Skin area	Treatment	Swabbing of area	Pressure on swab	Bacteria count	Blood agar	
					% Hemolytic	% non-hemolytic
1	none	Once in each direction	Light	165,000	20	80
2	"	" " " "	Heavy	150,000	30	70
3	"	Twice " " "	Light	150,000	30	70
4	"	" " " "	Heavy	170,000	30	70
5	L.G.D* for 1 min.	Once " "	Light	45	0	100
6	"	" " " "	Heavy	50	0	100
7	"	Twice " " "	Light	89	0	100
8	"	" " " "	Heavy	75	0	100

* Liquid germicidal detergent

Swab counts obtained when the liquid germicidal detergent was not removed from the skin by sterile water prior to swabbing were similar to those where a 1 to 1000 solu-

An agent for skin disinfection must not be irritating to the skin if it is to be successfully employed in veterinary practice. A study was made of liquid germicidal detergent in this

respect. Three 3x3-inch areas were clipped on the left side of three dogs; area No. 1 was posterior and No. 3 was anterior with No. 2 between these two. Area No. 1 was scrubbed with soap and water for three minutes using a pledget of cotton, after which dry cotton was used to remove all of the lather. Germicidal detergent (undiluted) was used to scrub area No. 2 for eight minutes. Dry cotton was used to remove the excess lather. Area No. 3 was similarly scrubbed with liquid germicidal detergent for eight minutes. The excess of detergent in this area was then removed by thoroughly washing with sterile water. The skin of these areas was carefully observed each day. Since the results in all dogs were similar, only those of one dog are presented in Table III. A slight erythema was noted in each area. This apparently resulted from the mechanical action of the scrubbing and disappeared within three days. Leaving the undiluted liquid germicidal detergent on the skin after the scrubbing did not affect the skin adversely. Similar results have been obtained with horses and cows.

Two more dogs were used to determine the reaction of the skin of the ventral abdomen to scrubbing for two minutes with full strength liquid germicidal detergent, followed by shaving of the hair of the area using the detergent lather. The skin of dog No. 4 was observed daily following this treatment. An ovariectomy was immediately performed on dog No. 5. The condition of the skin and of the wound post-operatively is presented in Table IV.

When two-minute scrubbings with undiluted liquid germicidal detergent were made repeatedly, at five-minute intervals, on horses and cows it was found that wrinkling of the

TABLE III.—OCTOBER 28, THREE 3x3-INCH AREAS WERE CLIPPED ON THE SIDE OF DOG NO. 1: AREA NO. 1 POSTERIOR AND AREA NO. 3 ANTERIOR WITH AREA NO. 2 BETWEEN THESE TWO.

Date	Area 1	Area 2	Area 3
Oct. 29	Slight erythema	Slight erythema	Slight erythema
" 30	" "	" "	" "
" 31	" "	Very " "	Very " "
Nov. 1	Very " "	OK	OK
" 2	OK	OK	OK
" 3	OK	OK	OK
" 4	OK	OK	OK
" 5	OK	OK	OK

Treatment applied:
Area No. 1—Scrubbed with soap and water for eight minutes.
Area No. 2—Scrubbed with full strength germicidal detergent for eight minutes, excess wiped off—no washing.
Area No. 3—Scrubbed with full strength germicidal detergent for eight minutes, then area completely washed with sterile water to remove all detergent.

Dog No. 4	Abdomen prepared as indicated above but no surgical incision made.
Date	Condition
Oct. 29	Slight erythema
" 30	Very "
" 31	" "
Nov. 1	OK
" 2	OK
" 3	OK
" 4	OK
" 5	OK
OK	

Dog No. 5	Abdomen prepared as indicated above then ovariectomy performed.
Oct. 29	Slight erythema-operative wound OK
" 30	" " " " "
" 31	Very " " " " "
Nov. 1	OK " " " "
" 2	OK " " " "
" 3	OK " " " "
" 4	OK " " " "
" 5	OK " " " "

Table IV. — October 28 ventral abdominal area 3x6 inches was clipped with coarse clippers, then scrubbed for two minutes with full strength germicidal detergent and wiped with dry cotton; more full strength germicidal detergent used as lather and area shaved.

skin usually appeared on the third day in those areas that had five or more scrubbings. The thickened and wrinkled skin became very dry and scaled off over a period of 28 days. The areas scrubbed one, two and three times remained unchanged except for a slight thickening of the skin as a result of the mechanical action, this lasted only four days or less. The skin of the area scrubbed four times became slightly thickened and then became dry and slightly scaly before returning to a completely normal appearance within two weeks. Dilutions of one to five liquid germicidal detergent in water have been used on dogs, cows and horses with similar results. These data show that the liquid germicidal detergent can be used for the pre-operative preparation, cleansing and disinfection, of the skin.

TABLE V.—COMPARATIVE RESULTS ON SKIN DISINFECTION OBTAINED WITH LIQUID GERMICIDAL DETERGENT, SOAP AND WATER ALONE AND FOLLOWED BY AN APPLICATION OF TINCTURE OF IODINE USING BOTH STERILE WATER SWABS AND THOSE CONTAINING INHIBITOR SUBSTANCES.

Skin area	Treatment	Time of swab after treatment	Type of sterile swab water	Bacteria count	Blood agar	
					% Hemolytic	% non-Hemolytic
1	none	Immediately	Plain water	400,000	5	95
2	none	15 minutes	" "	330,000	5	95
3	1 to 5 L.G.D. for 1 min.	Immediately	" "	10	0	100
4	" "	15 minutes	" "	50	0	100
5	" "	Immediately	1 to 1000 lauryl sulfate	20	0	100
6	" "	15 minutes	" "	80	0	100
7	" " water wash	Immediately	Plain water	100	0	100
8	" " "	15 minutes	" "	120	0	100
9	" " "	Immediately	1 to 1000 lauryl sulfate	80	0	100
10	" " "	15 minutes	" "	150	0	100
11	Soap and water for 1 min.	Immediately	Plain water	200,000	1	99
12	" "	15 minutes	" "	150,000	5	95
13	" tincture of iodine	Immediately	" "	10	0	100
14	" "	15 minutes	" "	30	0	100
15	" "	Immediately	1% sodium thiosulfate	20	0	100
16	" "	15 minutes	" "	80	0	100

* Liquid germicidal detergent

A study was made to determine the comparative value of liquid germicidal detergent, soap and water alone, and soap and water followed by an application of tincture of iodine as skin disinfectants. This was done on horses and cows; since the data were similar the results obtained on one cow are presented in Table V. In each case a second swab was taken 15 minutes after the first one; no significant difference was obtained between these two at any time. In like manner no significant effect was noted, in this experiment, by the use of inhibitors in the swab water. Washing the area with sterile distilled water following the liquid germicidal detergent resulted in a very slight increase of bacteria count, from a range of 10 to 80 to a range of from 80 to 150. The use of soap and water removed some of the bacteria as revealed by the counts of 150,000 and 200,000 after cleansing as compared to 330,000 and 400,000 bacteria from the control or no treatment area. The application of tincture of iodine to the area cleansed with soap and water, reduced bacteria counts of 150,000 to 200,000 to 10 to 80; these compared favorably with those obtained following the use of liquid germicidal detergent. A further attempt was made to measure the comparative germicidal action of liquid germicidal detergent with other methods of preparing surgical fields. In this experiment specific and comparable areas of skin in the left triceps region of 10 horses were used. These areas were treated with undiluted liquid germicidal detergent, with detergent diluted with water, one part to five, with soap and water alone, and with soap and water followed by the application of 70% alcohol. Swab bacteria counts

after using these methods of treatment were made. After germicidal detergent the count was 360; after soap and water, 27,500; and after soap and water followed by alcohol, 5,700. Following this a local anesthetic was administered and an incision two inches long was made in each of the above areas. A sterile scalpel was used for each incision. A slice of tissue one-eighth inch wide by 0.5-inch long was removed from the margin of each wound with sterile forceps and scissors and dropped into a 10cc tube of tryptose dextrose broth. The tubes were observed after 48 hours of incubation at 37°C. This is a relatively critical test, since it involves the entire thickness of the skin.

The tube containing the skin from the area cleansed with liquid germicidal detergent (both undiluted and the one to five dilution) yielded only a pellicle of Bacillus bacteria; the rest of the tube was free from bacterial growth. This occurred irrespective of whether or not sterile water had been used. The skin from the area cleansed only with soap and water yielded a profuse growth of bacteria of the following genera: Bacillus, Staphylococcus, Streptococcus and Escherichia. The application of 70% alcohol, after cleansing with soap and water, made a marked difference for here the skin carried Bacillus bacteria that formed a pellicle and staphylococci that resulted in a clouding of the medium. These data demonstrate the desirable skin disinfectant action of liquid germicidal detergent on the bacterial population of the skin.

Each wound was cleansed daily with the same agent, that was used to prepare the skin for the surgical incision. The wound in the areas prepared by and cared for daily with soap and water, only, healed in an average of 12 days, those also treated with the 70% alcohol prior to surgical incision and cared for daily with alcohol, healed in an average of 11 days while those with liquid germicidal detergent healed in an average of 10 days. As a result of the very good results obtained in these studies a series of 40 ovariectomy and neoplasm removal operations were performed in dogs where the skin was prepared by scrubbing with undiluted liquid germicidal detergent. The hospital records are on file in the Small Animal Hospital of the Michigan State College; the results in each case were good. In like manner the liquid germicidal detergent (undiluted and one to five dilution) has been successfully used in over 100 operations on

TABLE VI.—THE COMPARATIVE VALUE OF LIQUID GERMICIDAL DETERGENT (1 OZ. PER GALLON OF WATER) AND CLEAR WATER USED TO WASH THE UDDERS AND TEATS AS DEMONSTRATED BY THE RESULTS OF THE BACTERIOLOGICAL EXAMINATION OF THE MILK FOR MASTITIS STREPTOCOCCI AND THE PRESENCE OF LIVING STREPTOCOCCI IN THE WASH SOLUTIONS.

Cow no.	Series A. Udders washed with liquid germicidal detergent		Series B. Udders washed with clear water	
	Bacteriological test of milk	Viable strep. in wash solution	Bacteriological test of milk	Viable strep. in wash solution
1	-	-	-	-
2	-	-	-	-
3	-	-	-	-
4	+	-	+	+
5	-	-	-	+
6	-	-	-	+
7	+	-	+	+
8	-	-	+	+
9	-	-	+	+
10	+	-	+	+
11	+	-	+	+
12	-	-	+	+
13	-	-	+	+
14	+	-	+	+
15	+	-	+	+
16	+	-	+	+

+ indicates streptococci

horses, cows, goats, sheep and pigs involving surgical incision of the skin; these records are on file in the Large Animal Hospital of the Michigan State College. Additional numbers

For proper collection of milk samples for microscopic examination the udder and teats are first cleaned with a suitable antiseptic solution to prevent contamination of the sample by organisms from the surface of the udder and teats. In these tests one ounce of liquid germicide detergent was used to the gallon of wash water. Washing with this solution was completely successful in avoiding contamination of the milk sample and in preventing the carrying of organisms from one udder to another although the same cloth was used in washing all the udders.

of operations are being added to this list daily. In like manner, we are now successfully treating infected wounds with the liquid germicidal detergent.

To demonstrate the practical value of liquid germicidal detergent in the control of bovine mastitis and in quality milk production a series of field tests were made. Table VI presents the results of a comparative study on cleansing the udders with clear water and with a solution of the liquid germicidal detergent (one ounce to the gallon of water). A herd of 16 cows was selected in which cows No. 4, 7, 10, 11, 14, 15 and 16 were infected. Samples of milk were collected, starting with cow No. 1 and proceeding through the herd to cow No. 16, Series B. In this series of tests the udders were washed with clear water. The same water and cloth was used to wash all udders. The milk and water tests were negative until cow No. 4 was tested. This milk sample and the wash water sample collected at this time both yielded streptococci. The milk samples from cows No. 5 and No. 6 were negative for streptococci, but the contamination of the wash water remained. The contamination of wash water was increased when cow No. 7, infected with streptococci, was sampled. As a result all of the subsequent milk samples of Series B collected in the herd were positive for streptococci. Thus false positives were obtained on cows No. 8, 9, 12 and 13, and it is important to note that these cows were exposed to infection by this means.

Immediately after the samples were collected for Series B, the udder of each cow was washed with a solution of liquid germicidal detergent (one ounce to the gallon of water). Milk and wash water samples were collected for test. The data given in Table VI, Series A, indicate that the wash water remained free of living streptococci throughout the sampling period, and that streptococci were isolated from the milk of cows No. 4, 7, 10, 11, 14, 15 and 16. Repeated previous tests had demonstrated these to be the infected cows in the herd. No mechanical carry-over of streptococci from the infected to the noninfected cows occurred. This is important in the control of udder infection in a dairy herd.

Summary

The liquid germicidal detergent studied was

After the udder was cleansed with the liquid germicidal detergent solution, milk samples were collected for bacteriological examination by milking directly into test tubes (after discarding the fore milk. In these tests the samples were negative from known, noninfected udders, thus showing contamination from the washed surface of the udder had not occurred.

satisfactory as a skin cleanser and disinfectant when used undiluted, or in a dilution of one part to five with water. Swab bacteria counts were made and sections of skin were examined bacteriologically to determine the value of liquid germicidal detergent as a skin disinfectant. Over 140 operations have been successfully performed on small and large animals following the pre-operative preparation of the operative area with liquid germicidal detergent.

A solution of liquid germicidal detergent (one ounce to the gallon of water) is recommended for udder disinfection in a program of quality milk production and control of udder infection.

Porcine Virus Encephalomyelitis and Its Possible Biological Relationship to Human Poliomyelitis

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PORCINE virus encephalomyelitis has been recognized thus far, only in Europe. Synonyms used for the disease are infectious pig paralysis, Teschen disease, Bohemian pest, and *encephalomyelitis enzoötica suum.* It was first observed as a disease entity in Czechoslovakia by Trefny in 1929,[1] although Klobouk[2] noted a clinically similar disease in Moravia in 1913. Klobouk later (1930) was the first to transmit the disease experimentally. The breakdown of veterinary sanitary controls in Central Europe during World War II apparently gave the opportunity for the disease to be widely disseminated. Since 1939, it has been reported in Germany, Austria, Hungary, Jugoslavia, Bulgaria,[3] France,[4] and Switzerland.[5] At the present time porcine virus encephalomyelitis is rapidly approaching swine erysipelas and hog cholera as a major swine scourge in several countries. In Czechoslovakia alone it has been estimated that over 50,000 pigs contracted recognizable virus encephalomyelitis in 1946.[14]

The senior author visited Czechoslovakia in April 1947, where he observed the disease and was able to obtain tissues for histopathological study. Porcine virus encephalomyelitis has been scantily considered in American literature, one of the underlying reasons undoubtedly being the difficulty of access to original reports.† We feel that the disease merits close scrutiny because of its possible appearance in the United States, as well as because of some broader implications to the biology of infectious diseases, particularly human poliomyelitis.

Nature and Distribution of the Virus

Well controlled experiments have demonstrated almost incontrovertibly that a separate and distinct virus is the cause of porcine virus encephalomyelitis[2, 3, 6, 8, 10, 13, 27] (Footnote this page). Some doubt exists, in the minds of a few veterinarians, that an unknown filterable virus is involved. Some feel, for example, that infectious pig paralysis is the result of an aberrant manifestation of swine influenza, hog cholera, or Aujeszky's disease (pseudo-rabies), although there is no experimental evidence to support these opinions.

Klobouk[2] and Fortner[8] have studied some properties of the virus relative to its cultivation and its resistance to chemical and physical agents. The virus passed through Berkefeld N, V, and W filters. Attempts at cultivation in artificial media and in chicken embryo failed. It resisted putrefaction for six days, but lost infectiveness after 21 days. The virus remained potent 23 days after drying at room temperature, but was found ineffective by the 54th day. It was destroyed by heating to 70° C. for one-half hour. Pickling in brine did not destroy the virus in tissues after 21 days at 6 to 10°C. It remained alive for at least three months when held at minus 15°C., and over 20 months preserved in 50% glycerine kept at 0°C. Three per cent sodium hydroxide killed the virus within one to three hours. Two per cent formalin required one to nine hours to destroy the virus. Langner[38] states that sunlight is lethal to the virus in two hours.

According to Klobouk and Kost'ansky (footnote † p. 330), the virus was found, invariably, in the central nervous system of diseased pigs. They also found it present, at times, in the stomach mucosa, but could not detect it in the meat, blood or intestinal contents. Fortner[8] demonstrated the presence of the virus in the feces of diseased animals, but was unsuccessful with the urine, nasal secretions, muscle tissue, sciatic nerve, bile, and salivary glands. He was uncertain about its presence in the blood. Schmidinger[9] cited an instance where he felt that accidental transmission of the disease occurred in 20 piglets which had ingested blood from a diseased pig. Schaefer and Heynen,[10] in controlled experiments, however, failed to detect the virus in the blood stream. They felt that if the virus appears in the blood stream during the course of the disease, it does so in small amounts and only transiently.

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†Until 1939, the only published works on porcine virus encephalomyelitis were by Czechoslovakian veterinarians written in the Czech language. Lépine 12 cites this difficulty, and in the preparation of his review of the disease, written in 1942 during the German occupation of Paris, he had to depend upon personal communications from various German authors. Most of the recent literature dealing with this disease was published in veterinary journals of the then Nazi-controlled territories. It is still very difficult to consult original works published after 1940. The best Czech reports, according to Lépine, are: A. Klobouk; Zver. Rozpravy 9: pp. 73, 85, 217, 1935; Zver. obzor. 24: pp. 436, 460, 477, 1931; Kost'ansky, Ber. IIe Congres tch. sl. veter. Brunn, pp. 163, 196, 1936; Domansky, Zver. obsor., p. 83, 1936.

Experimental Transmission

Except for a vague report,[15] and except for vague references concerning other laboratory animals,[15,21] and an isolated notation of the susceptibility of dogs and cats (Macek cited by Süss[16]), all unsupported by the main body of evidence, the pig has been found to be the only animal experimentally, as well as naturally, susceptible to the virus of pig paralysis. All attempts at transmission of the disease, even by intracerebral inoculation, have failed in mice, rats, guinea pigs, sheep, rabbits,[13] and the monkey.[12] (Klobouk[2] states that, to his knowledge, transmission has been tried in only one monkey). Cattle and calves were refractory to subcutaneous inoculation.[13]

According to Klobouk,[2] 1cc of a 1:1000 dilution of diseased brain and spinal cord is sufficient to cause infection, although more concentrated inoculums (1:10) are used routinely in experimental work to assure consistent results. Weidlich,[6] referring to impressions of Klobouk and Kost'ansky, states that the central nervous system of a diseased pig is most infectious, when the animal is paralyzed and the temperature is at the maximum and beyond that point infectiousness diminishes.

Diernhofer[13] succeeded uniformly in transmitting the disease to pigs weighing 8 to 10kg. He reports success by Kost'ansky with pigs weighing 3 to 7kg. Diernhofer's results were erratic when larger animals were employed. Klobouk[2] preferred to use pigs weighing between 10 and 12kg. Success[3] was rare with pigs weighing over 20kg.

The route of inoculation is important. Intracerebral or subdural inoculations have been most consistent in reproducing the disease. Klobouk first proved the transmissible and filtrable nature of the virus of pig paralysis by infecting 15 of 16 pigs by means of intracerebral inoculation of a filtered brain-spinal cord emulsion. This method of inoculation has been used routinely during the past 15 years in studies in the Czechoslovakian National Institute of Health in Prague, the Veterinary School in Brno, and for the production of vaccine at the Ivanovice Veterinary Institute. It should be noted, however, that not all inoculated piglets appear to contract the infection, although well over 80% react with clinical symptoms (not necessarily paralysis).

In 1942 and 1943 the German Office of Sanitation and Health* made large-scale studies of the experimental transmission of pig paralysis.[3] They succeeded in transmitting the disease to 362 pigs, of which 349 had been subjected only to intranasal inoculation. They feel that the nasal route is the natural portal of entry of the virus. Infection through intramuscular and subdural inoculation also succeeded, but failure resulted when intracutaneous, subcutaneous, intravenous, intravaginal, and intraperitoneal routes were tried. Klobouk,[2] however, was successful in using the subcutaneous route in three of 16 pigs. Three of 29 pigs acquired the disease by contact infection in the German experiments. Klobouk and Kost'ansky (footnote p. 330) were previously unable to establish contact infection. Klobouk[2] successfully infected four of 11 pigs by feeding them a mash made from cerebrospinal tissue of infected pigs.**

As was stated previously, intracerebral inoculation is not always successful in transmitting the disease to piglets. Research workers in Czechoslovakia have noted a variable, but small number of inoculated piglets which show only mild symptoms of infection (increased temperature and anorexia) for a few days followed by full recovery. Klobouk[2] succeeded in reinfecting animals, fatally, five months after they had recovered from a mild infection; indictating that immunity, if any, is produced by a non-paralytic attack, is of relatively short duration. Lépine[12] points out the comparison with experimental poliomyelitis in monkeys where infection accompanied by paralysis does not necessarily protect the animal against subsequent reinfection.

Epizootiological Aspects

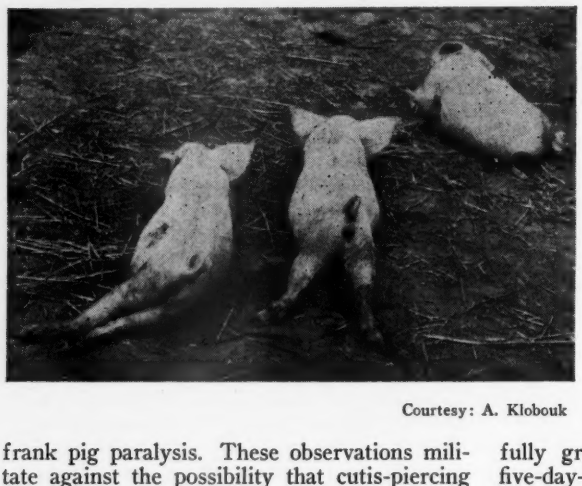
Opinions vary widely concerning the natural mode of transmission of infectious pig paralysis. Veterinarians in Czechoslovakia lay particular stress upon the introduction of newly purchased pigs, or feeding the herd on parts of a diseased carcass as a prelude to an outbreak. Farmers often attribute the infection to the feeding of raw garbage. Contaminated drinking water,[16] dung, liquid manure, rats and mice,[17] and kitchen waste;[7] all without the support of experimental proof, have been accused of being vehicles of infection.

If biting or sucking insects play any role in the disease, it is probably only as mechanical carriers of the virus, rather than as an indispensable biological link in the chain of infection. To support this contention, one can consider the failure to detect virus in the blood stream of infected pigs,[10] and the extreme difficulty of infecting animals by parenteral inoculation except *via* the intracerebral and intranasal routes. Neither of the latter two portals would be factors in the case of biting or suck-

*According to Klobouk, these experiments were conducted under the supervision of Fortner.8

**The report of the International Bureau of Epizootics,3 as well as Weidlich6 states that Klobouk also succeeded in transmitting the infection to six pigs by feeding them various organs, flesh, blood, urine and intestines and their contents, from 21 diseased animals. This was not verified in a latter personal communication from Klobouk who, however, has stated that though he was unsuccessful, Fortner, in the German experiments had accomplished oral infection in one of 14 pigs. Lépine,12 also states that oral transmission of the disease has been experimentally confirmed by others.

ing insects. The relative lack of success in experimental transmission utilizing the subcutaneous route, will be emphasized later in considering the use of vaccine, where it will be pointed out that subcutaneous inoculation of the vaccine will not produce the disease, while intracerebral inoculation of the same vaccine often causes



Courtesy: A. Klobouk

Fig. 1. Showing complete flaccid paralysis.

frank pig paralysis. These observations militate against the possibility that cutis-piercing insects act as prime agents in transmission of the disease. One cannot disregard, however, the common flies (blowfly, housefly) as mechanical disseminators of the virus. In the epidemiology of human poliomyelitis, their possible importance is stressed, particularly during the summer season.[19] It should be noted that infectious pig paralysis occurs the year round, and that during the winter and spring of 1947 a large-scale epizoötic raged in Czechoslovakia. This would seem to indicate that, on the whole, insects do not play an important role in the epizoötiology of the disease.

One of the basic problems to be definitely resolved in considering the natural transmission of pig paralysis is that of the usual portal(s) of entry of the virus into the body of the host. On the basis of controlled experimental transmission, it is fairly safe to say that the principal portals in natural infections are the nasal and digestive tracts. At this stage of knowledge concerning the disease, one can only say that it may be either of the two or a combination of both. Field and experimental observations tend to incriminate feces as the main vehicles for disseminating the disease. This does not preclude, of course, the possiblity of inhalation of material contaminated with feces containing virus, either as dust airborne infection, or in a wet form as droplet nuclei. Porcine eating habits, including rooting and an omnivorous diet, favor equally the inhalation and intestinal routes. The hypothesis of nasal entry, however, cannot be uncritically accepted without further basic research analogous to that in the field of human poliomyelitis which, in recent years, has caused an almost complete shift of emphasis from the naso-pharynx to the intestine as the locus of virus penetration.[19]

Natural infection may strike very young or fully grown swine. Klobouk[2] reported that five-day-old piglets, as well as hogs weighing 200kg. have succumbed to natural infection. According to him, an average of 50% of pigs exposed under natural conditions become clinically affected, and approximately 70% of those that are visibly sick die. These approximate figures vary in different outbreaks; apparently depending upon previous experience with the disease in a locality. In areas reporting the disease for the first time, all age groups appear to be equally affected. In districts where the disease is enzoötic, young pigs and newly introduced swine suffer most.

Müssemeier[18] feels that under natural conditions, pigs affected by the disease do not acquire immunity. Fortner,[8] however, is convinced that affected animals which have survived the paralytic stage are solidly immune to subsequent infection. This latter opinion is in accord with natural manifestations of the disease as usually observed in Czechoslovakia. Apparent reinfection of herds has been noted, although rarely. This may indicate strain plurality of the virus, a possibility which will be commented upon later.

Unfortunately, reliable statistics covering large numbers of animals are not available to determine more accurately the position of age-group affection in the enzoötic-epizoötic manifestations of the disease. Such information would contribute to better analysis of the dynamics of the disease in terms of biological history and immunity.

Further elucidation of these matters may be

possible by other means. According to Klobouk,[2] Fortner claims that convalescent serum has both preventive and curative properties. This would indicate the presence of specific antibodies in recovered animals. Unfortunately, serum-virus neutralization tests have not been made (Klobouk). It is well known that serum-virus neutralization tests have been extremely useful in discerning past contact of man and animals with specific viruses (equine virus encephalomyelitis, yellow fever, avian pneumoencephalitis, the influenza viruses). The possible pitfalls of serum-virus neutralization tests must not be overlooked, however. For example, great confusion resulted from immunological studies of human poliomyelitis because of the fact that only one standard passaged strain of virus was used in testing.[19] If successful of execution, however, these tests carried out on a large scale, not only in areas where the disease is enzoötic, but also in contiguous and far-removed territories where the disease has not yet been recognized, would aid considerably in defining more clearly the epizoötiology of infectious pig paralysis. The tests should be made on both domestic and wild animals, particularly rodents, and on animals closely related to the domestic pig. (Müssemeier, according to Lépine[12] reports the wild boar as being susceptible to the disease.)

Other deficiencies in our knowledge which should be noted are concerned with the physicochemical properties of the virus and the pathogenesis of the disease.

In spite of these serious limitations, sufficient knowledge is available to venture the formation of a tentative epizoötiological framework for infectious pig paralysis. We are dealing apparently with a relatively new disease which appeared fairly suddenly in a limited area (Teschen, Czechoslovakia). Dissemination of the disease was gradual during a period of relative stability when movements of animals and sanitary practices were well controlled. With the breakdown of these stabilizing forces shortly before and during World War II, the disease spread extensively into neighboring countries. There is little doubt that any wide dissemination of the disease before 1939 would have been observed almost immediately because of the then well-organized veterinary services in some of the countries since involved (Austria, Germany, France, Hungary, Switzerland).

The familiar pattern of a new disease striking a community is presented in the spread of infectious pig paralysis. In the epizoötic phase, all age groups are, at first, involved. When the disease has become firmly established, *i. e.* enzoötic, the brunt falls upon the young and newly introduced animals which lack previous experience with the disease. The opinion expressed by several authors that infectious pig paralysis is not very communicable by direct contact[2, 3, 6, 11] is not necessarily correct. We suggest the probability that, within a herd, subclinical infections and possible immunity from previous exposure are responsible for masking the actual communicability of the disease, except in those instances where sudden mutation of the virus has converted it into an extraordinarily virulent strain. Apparently this latter phenomenon occurs at times, since whole herds have been decimated in several outbreaks of the disease in Czechoslovakia.

Pathogenesis

Detailed and accurate definition of the pathogenesis of infectious pig paralysis will have to await more stringent research.

Hutyra *et al.*[7] feel that the virus is distributed by the blood throughout the body including the central nervous system, although they may mean this to apply to Aujeszky's disease which they are describing simultaneously.

Evidence to indicate a strong possibility that the nervous system acts as the pathway for the virus as in human poliomyelitis, may be found in transmission experiments showing the large percentage of successes accompanying intracerebral and intranasal inoculation, the fairly extended incubation period, and the failure to detect the virus in most parts of the body except the gastrointestinal tract and central nervous system.

Symptomatology

Descriptions of the symptoms and signs observed in infectious pig paralysis have been made by several authors.[3, 6, 7, 11, 12, 16, 17, 21, 22, 31] The following account is based upon these reports, and personal observations made in Czechoslovakia by one of the authors.

The incubation period varies from three to 31 days. In experimental transmission, the incubation period averages 14 days, while in spontaneously occurring cases, the disease usually breaks out two to three weeks after known or suspected exposure (introducing new animals to a farm, feeding diseased carcasses, etc.).

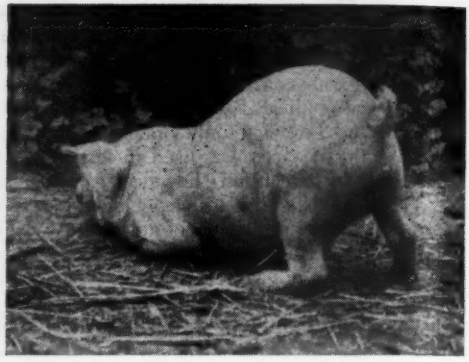
Prodromes.—There is a prodromal stage which usually lasts from one to three days. Sometimes it is over within a few hours, and rarely does it last as long as six days. This stage is characterized by a slightly increased temperature (104 to 105°F), although at times the temperature may rise sharply (106.7°F). During this period the animal shows lassitude, loss of appetite, general malaise, and depression, sometimes a slight ataxia of the rear limbs, and infrequently vomiting.

Nervous Excitement. A stage of irritability

succeeds the prodromal signs and lasts for a period of two to four days as it gradually evolves into the paralytic stage. It is not uncommon, however, for the paralytic stage to appear without a preceding irritative phase. The irritative signs almost always include generalized muscular tremors and tonic-clonic spasms, especially of the limb muscles. Generalized convulsions which resemble convulsive rickets are common. These convulsions may be precipitated by handling, a sudden noise, or without apparent external cause. If the animal is standing, the head begins nodding, gritting of the teeth is heard, frothy saliva appears at the corners of the mouth, frequently nystagmus sets in, and the limbs pass into a rapid tonic-clonic spasm. The animal may sink back on its haunches during the convulsion, or it may fall onto its side where the convulsion continues for a few minutes. It then lies quietly from exhaustion for a short period before regaining its feet, after which it appears quite normal. Hyperesthesia is often present during the irritative stage and the pig may suddenly squeal in pain. Chewing the bedding and circling may occur, but these actions are rare. The appetite may be affected during this period, and the temperature usually remains only slightly elevated.

Paralysis. The paralytic period is ushered in gradually, especially in less acute infections. The animal walks stiffly because of muscular rigidity, and stumbles frequently from failure to place the legs properly for adequate support. The hind legs show the greatest and most frequent involvement, although complete paralysis may involve all four members. Ascending, progressive paralysis reveals itself by the second or third day after involvement of the hind legs, at which time the forelegs are affected. The animal loses power to support the rear quarters and often assumes a dog-sitting position. Complete flaccid paralysis of the hind legs (Fig. 1), or a less severe paraplegia may occur. When prodded to movement, the pig may partially support its hind quarters and drag its body by walking on the dorsiflexed phalanges of the front limbs (Fig. 2). The patellar reflex is totally absent in the fully paralyzed limbs, and markedly diminished in paraplegic animals. Paralysis may involve the neck muscles so that the animal cannot lift its head. The tongue and muscles of the mandible also may be paralyzed. Diminished sensibility is the rule, but sometimes hyperesthesia is present. The general convulsions marking the irritative stage may occur also during the paralytic period. The voice is usually altered in character, having a hoarse, toneless sound, or it may be lost completely. Rare cases of vesicular eruptions on the snout have been noted. The temperature during the paralytic stage is usually normal or subnormal, although rarely it may remain slightly elevated for as long as two months. Conjunctivitis is usually marked. The appetite remains good, and general alertness is maintained. In acute cases, death usually occurs from respiratory paralysis within three days after the onset of paralytic signs.

Approximately 50 to 70% of visibly affected animals (not necessarily paralytic) usually die during the first two weeks, although mortality sometimes reaches 90 and even 100%. About one-half of the survivors recover completely within three to six weeks. Earlier recoveries (one to two weeks) are noted in non-paralytic animals. Paralysis persists in the remaining group of animals for many months, although gradual improvement, but never full recovery, may occur (Fig. 3). In long-standing paralysis, atrophy of the leg muscles is the rule. Apparently, more complete recoveries occur in young than in older animals, but it has also been observed that overall mortality is greatest in piglets under four weeks of age.



Courtesy: A. Klobouk

Fig. 2. Showing paralysis of the forelegs.

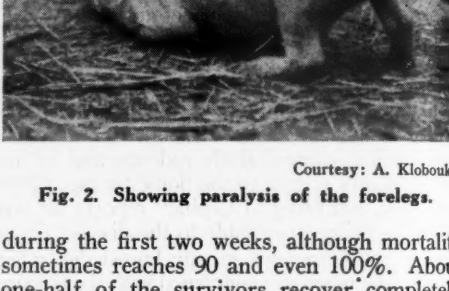


Fig. 3. Showing residual paralysis.

Relapses are rare but are known to have occurred. One experimental pig, seen by one of

the authors, became paraplegic two weeks following full clinical recovery from intracerebral inoculation and resulting paralysis. It had remained paraplegic, but otherwise normal, for over ten months when last observed. In this animal, the hind legs remained weak, but atrophy of the muscles was not apparent.

Klobouk feels that the disease now seen in Czechoslovakia is less acute clinically, than that observed before World War II.

Anatomical Changes

At post-mortem examination, usually few or no macroscopic changes can be detected. The lesions occasionally seen are non-specific, and are often due to secondary causes such as terminal bronchopneumonia and decubitus. Some authors, however, emphasize certain symptoms and lesions, which they consider to be important. These include catarrhal conjunctivitis, pronounced congestion of the nasal mucosa with small hemorrhages, sometimes hyperemia and edema of the lungs,[7] and disseminated pneumonic foci throughout the lungs.[22] Macroscopic changes sometimes seen in the central nervous system are congestion of the meninges, cerebral edema, "slight serous infiltration of the pia mater," punctiform hemorrhages in the brain, and congestion, but seldom hemorrhages, in the spinal cord.[7, 12] Macek[23] stresses changes in the mucosa of the digestive tract. The intestinal and gastric mucosae are swollen, plicated and exceedingly hyperemic. In addition, the intestinal mucosa shows excessive mucus, and longitudinal or diagonal folds. These folds are red in the acute stages of the disease and brown or gray in chronic cases, or both color alterations may be coexistent.

Klobouk and Domansky (footnote p. 330) were the first to describe the characteristic histopathological changes in the central nervous system which occur in pig paralysis. Detailed studies have also been made by subsequent workers,[32, 33, 35, 36, 37, 40] particularly by Kment.[34] The observations of all these workers are in essential agreement. All point out the striking analogy of the lesions observed in pig paralysis with those of acute anterior poliomyelitis in human beings, particularly if the widespread distribution of the lesions in human poliomyelitis is kept in mind. The following description of the changes in the central nervous system is a composite of those described in the literature and those seen in personal study.

The gross changes in brain and cord have already been noted. Microscopically the lesions are essentially those of a poliomyelitis and polioencephalitis characterized by advanced degenerative changes in the nerve cells, perivascular infiltrations and glial proliferation. The anterior horn cells of the cord and particularly of the lumbar cord are predominantly and characteristically involved. The brain, as in human cases, almost invariably shows involvement of the grey matter of the basal ganglia, cerebral peduncles, pons, medulla oblongata, and cerebellum. The lesions here consist of a more or less generalized inflammatory cell infiltration with perivascular collections of round cells, foci of ganglion cell

Fig. 4. Section of cerebellum showing marked lymphocytic leptomeningitis and focal cellular infiltrations (70 x).

degeneration and glial proliferation. In the cerebellum (Fig. 4) there are constant degenerative changes in the granular and molecular cell layers, in the Purkinje cells, an almost constant lymphocytic leptomeningitis of variable degree, perivascular infiltrations, and glial proliferations, as in the other portions of the brain just described. The changes in the pons, though well pronounced are usually of less intensity than in the medulla oblongata. In all these sites, there may be slight involvement of the white matter. This usually manifests itself as round cell infiltrations but there is a definite diminution in intensity as the white matter is approached and involved. The cerebrum and Ammon's horn are the least damaged of the brain structures, showing only congestion, and occasional perivascular lymphocytic collection and here and there very slight focal and diffuse lymphocytic cell infiltrations.

The most striking and characteristic changes are found in the spinal cord. In every case the grey matter, particularly of the anterior horn, is diffusely and focally infiltrated. The most advanced changes are in the motor ganglion cells of the anterior horns. These show the en-

tire gamut of degenerative to necrotic changes —chromatolysis, vacuole formations, karyorrhexis to complete dissolution (Fig. 5). Neur-

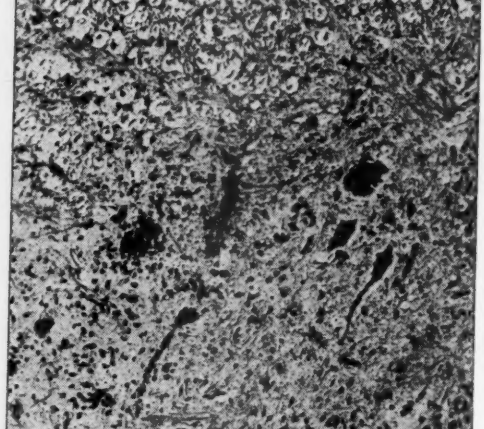


Fig. 5. Spinal cord—anterior horn region showing degenerative changes in motor anterior horn cells, neuronophagia and focal cellular infiltrations (95 x).

onophagia is abundant (Fig. 6). These changes are described in detail by Kment who divides them into two overlapping and intermingling groups, consistently present in every instance.

of a single sequence of liquefaction of cell cytoplasm and nucleus with the appearance of Nissl's rings, vacuole formation, karyorrhexis leading to the shrinkage of the cells, deformation and loss of its cellular outlines until a dark basophilic sharply angular mass remains to be beset and removed by neuronophagia. In addition there is a perivascular infiltration, chiefly of lymphocytes and an accompanying focal and diffuse glial proliferation. Similar changes are present in the grey matter of the lateral and posterior horns but to a less marked degree. These changes affect all levels of the cord, particularly the cervical and lumbar cords and especially the latter.

The white matter of the cord shows few alterations, usually only an insignificant perivascular infiltration which becomes weaker and soon disappears as the grey matter is left behind. No glial masses are observed in the white matter. The pia mater of the cord is slightly involved or not at all. No inclusion bodies are seen. In the chronic form the neurons are frequently involved in a granular fatty degeneration. The spinal ganglia are always strikingly affected showing the presence of marked interstitial infiltrations of lymphocytes and macrophages, cellular degeneration and neuronophagia. The changes in spinal ganglia were first described by Kment. Unfortunately, the ganglia changes are not specific. They have been found in hog cholera although less frequently and in much less pronounced degree.

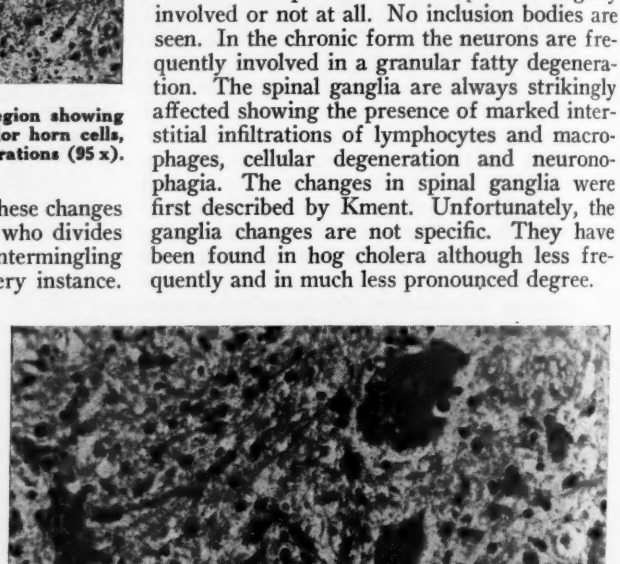


Fig. 6. High power field of same region as in Fig. 5, showing degenerative changes in motor anterior horn cells and neuronophagia (290 x).

In one, liquefaction dissolution is dominant, in the other, shrinkage and chromatolysis with terminal neuronophagia are the ultimate fates of the cells. To other workers these two sets of changes represent merely successive phases

In summary the pathological lesions are essentially those of a polioencephalomyelitis, predominantly present in the spinal cord and principally in the lumbar region. The striking similarity both in nature and distribution to

lesions observed in human poliomyelitis is apparent.*

Diagnosis

The changes described in the foregoing do not arise simultaneously and in equal intensity in the different parts of the involved central nervous system. In the first days of the illness, inflammatory alterations are well marked in the cord and basal regions of the brain. Only later, apparently, do the changes develop in other regions. It is on such considerations as the times of appearance of the lesions as well as on their degree, their character, and the extent of involvement, that a differential diagnosis can be based. Some believe that a differential diagnosis cannot be based on histologic studies alone. Others assert that if the above considerations be kept in mind, a differential diagnosis can be made in most instances. In general neither hog cholera, Aujeszky's disease, nor swine influenza is accompanied by poliomyelitis having the intensity and typical localization of that seen in pig paralysis. The time factors are especially important in the differentiation from hog cholera. In pig paralysis, inflammatory involvement of the cord is evident almost from the very start of the illness, in hog cholera changes appear in the cord only after five to seven days following experimental infection and only after 10 days or longer following the initiation of the natural infection. In the very earliest stages of pig paralysis, the lesions begin in the anterior horn cells of the spinal cord. At this stage they are easily differentiated from all other swine diseases of the nervous system. After the processes are generalized and have spread to the posterior horns of the cord and to other portions of the nervous system, the diagnosis is far more difficult. In summary, although none of the lesions described can in themselves be considered rigorously specific, their time of appearance, their localization, their intensity and character are usually sufficiently characteristic to permit a differential histologic diagnosis.

Accordingly, for etiologic diagnosis, it is recommended that sections from at least the cerebral cortical area, the cerebellum, and the lumbar spinal cord be studied. Paraffin imbedded and hematoxylin-eosin stained material is adequate. If there are only slight inflammatory lesions, of equal intensity in brain and cerebellum, the case is probably one of hog cholera. If the inflammatory changes are little developed in the brain and very marked in the cerebellum and spinal cord, the process is probably due to pig paralysis. This diagnosis becomes almost certain if lesions in the anterior horn cells predominate. If the inflammatory lesions are confined to but a few segments of the nervous system the diagnosis of encephalitis, myelitis, or meningitis from other causes (erysipelas, influenza, specific leptomeningitis, etc.) can justifiably be ventured.

Differential Diagnosis

The characteristic histopathological changes found in infectious pig paralysis in most instances remove any serious difficulty in differential diagnosis. Symptomatologically, however, some confusion may arise, especially early in the course of the disease.

Bacterial meningitis (Salmonella, Streptococcus, Staphylococcus, Listerella) are revealed by culture of the organisms. Although the convulsions seen in convulsive rickets have a striking resemblance to those seen in the irritative stage of pig paralysis, convulsive rickets is usually encountered only in young growing animals kept on a poorly balanced diet. Moreover, paralysis does not occur in convulsive rickets. In rabies, much greater excitement is noticed and infections are isolated or sporadic in occurrence. Mice inoculation tests can be used in doubtful cases. Pseudorabies (Aujeszky's disease) may offer greater difficulty, but the positive reactions seen in rabbits when injected with central nervous tissue from suspected pigs clearly distinguish this disease from infectious pig paralysis.

Changes in the central nervous system caused by swine influenza, as reported by Sedlmayer,[24] may give rise to some doubt in the differential diagnosis. However, the epizoötiological manifestations of swine influenza are distinctive enough in themselves to resolve doubts which may arise.* Furthermore, it should be noted that other investigators of swine influenza, Shope in particular,[25] have not reported the changes in the central nervous system described by Sedlmayer.

The possibility of the existence of hog cholera always arises early in the course of an outbreak of infectious pig paralysis, especially if the herd has not been immunized to the former disease. In hog cholera, however, the

*Attempts to isolate the poliomyelitis virus from various extra-human sources in epidemic areas formed the basis of an intensive study of 15,300 individual living specimens by three Michigan investigators, all from the Department of Epidemiology and Virus Laboratory, School of Public Health, University of Michigan. Their investigation was aided by a grant from the National Foundation for Infantile Paralysis.

According to the report of this investigation, "the best evidence of the transmission of poliomyelitis at the present time supports a person to person transfer." However, the authors caution, "one may not forget that the evidence was arrived at through processes of elimination rather than by scientifically approved experiments."

Stating that outbreaks of the disease are correlated with seasonal influences such as temperature, rainfall and the prevalence of animals and insects, the authors (Thomas Francis, Jr.M.D., Gordon C. Brown, Sc.D., and Lawrence R. Penner, Ph.D.) add that "it is difficult, if not impossible, in determining the transmission of poliomyelitis, to rule out extra-human factors completely."

*Seasonal manifestation of the disease, which occurs after a sudden change in weather during fall or early winter, results in full recovery of nearly all the animals in one to two weeks.

marked leucopenia and extreme weakness and torpor may be helpful in differentiating it from infectious pig paralysis. After one to two weeks this difficulty is considerably lessened because of the high (90 to 100%) mortality attendant upon hog cholera, and slight but typical macroscopic changes seen in uncomplicated hog cholera at post-morten examination (a few petechiae on the kidneys, slight hyperemia of the mucosa of the urinary bladder, congestion of the lymph glands, etc.). Furthermore, as previously indicated, histopathological lesions of the central nervous system are observable from the first day of illness in pig paralysis, whereas, in hog cholera, significant lesions are not observable until about the tenth day of the naturally contracted disease (Michalka[37]). Hog cholera complicated with other diseases (salmonellosis, erysipelas, pasteurellosis) offers no difficulties in differential diagnosis at post-mortem examination because of the marked anatomical changes which are seen in these complicating diseases.

Treatment

Under natural conditions, treatment is not, usually, undertaken since the veterinary services in most of the affected countries advise slaughter of an infected herd. In experimental work it has been observed that pigs surviving the first two weeks of the acute phase of the disease can be kept alive if hand feeding is practised.[2] It has been reported[3] that injections of Vitamin D in oil can prevent the occurrence of paralysis after experimental intranasal infection. This finding should be treated with reserve, until more fully substantiated, since paralysis following infection is far from inevitable, as has been noted previously.

Prevention

Biological products have been used extensively in attempts to control porcine virus encephalomyelitis. Although some success has been obtained with them under experimental conditions, their efficacy in the field has been disappointing. These unsatisfactory results apply particularly to Klobouk's phenolized vaccine and Kost'ansky's formol vaccine (footnote page 330) as evaluated in Czechoslovakia during the late 1930's. A brighter, but possibly misleading picture of results obtained with these vaccines under natural conditions is presented by other authors.[3, 7, 12, 26]

The vaccines consisted of phenolized or formalinized emulsions of ground brain and spinal cord tissue removed from experimentally infected animals slaughtered in the acute (late irritative or early paralytic) phase of the disease. Concentrations of 2 to 10% of tissue were used in doses of 3cc to 6cc given subcutaneously two weeks apart. Intracerebral inoculation of the vaccine was usually fatal.

Although clear-cut benefit was not obtained under natural conditions with the aforementioned doses, some protection was achieved experimentally by the use of much larger inoculums. Klobouk[2] gave six subcutaneous inoculations five to seven days apart, of 20 to 30cc of a 10% brain-spinal cord emulsion containing 0.5% phenol. These inoculations protected eight of 10 pigs from subsequent intracerebral inoculations of proved virulent tissue.

In Czechoslovakia at the present time, the official vaccine in use consists of a 10% brain-spinal cord emulsion containing 0.5% phenol, held at room temperature for 21 to 28 days. This vaccine is fatal when inoculated intracerebrally. Numerous control experiments at the Ivanovice Veterinary Institute have shown that 21 days after subcutaneous inoculation of 5cc of this vaccine, the animal is protected against intracerebral inoculation of virulent brain-spinal cord suspensions. Unfortunately, highly debatable results are being obtained from field use of this vaccine. Hruska[28] believes that a strain plurality of the virus is being encountered in the field rather than the standard passaged strain used for control work in the laboratory.*

Traub[27] reported good experimental results with an aluminum hydroxide absorbed vaccine. This consisted of a 20% brain emulsion, made from pigs intracerebrally infected and killed at the acute stage of the disease. The virus was absorbed on aluminum hydroxide and was inactivated by the addition of 0.1 to 1% formol after which it was heated for two days at 25°C. When inoculated intracerebrally, the vacccine was always fatal, but it was harmless when inoculated subcutaneously. Either one or two subcutaneous inoculations were made and the animals were tested 14 to 22 days after the first inoculation, or 26 to 30 days after the second by intracerebral inoculation of virulent nerve tissue. According to Traub, nearly all animals showed complete resistance. The pH of Traub's vaccine was 7.3. He reported that vaccine having a pH between 5.8 and 8.9 was effective, while it failed when below pH 5.5.

It is interesting to mention the assertion that protection against intranasal infection with the virus of infectious pig paralysis can be achieved for approximately two weeks by rinsing the nostrils with a 2% zinc sulfate solution.[3] Caution should be exercised before attributing too much importance to this finding, even if it proves to be well substantiated. It will be re-

*It should be mentioned that the lack of a suitable colloid mill has prevented the proper grinding of the nerve tissue into a homogenous mass. This may explain why the vaccine is fatal when inoculated intracerebrally, as living virus protected from the action of phenol may persist in the larger clumps. Also the action of phenol on the virus of infectious pig paralysis requires further study.

called that a similar procedure was advocated for the prevention of human poliomyelitis, but it has since been discarded.[20]

Apart from limited vaccination trials, the principal measures taken to control the disease are in the form of sanitary regulations, *i. e.*, slaughter of diseased animals and proper disposal of carcasses, disinfection, and control of livestock movements. These measures have been difficult to enforce, and even where they have been properly carried out,[12] they have failed to arrest the spread of the disease.

Possible Biological Relationship of Infectious Pig Paralysis to Human Poliomyelitis

Most close observers of infectious pig paralysis have noted certain resemblances of this disease to human poliomyelitis. For the most part, however, the analogy has been pointed out in passing and only in terms of possible identity of the two diseases. There is general agreement among authors, according to Lépine,[12] that "in spite of the striking clinical, anatomo-pathological and epidemiological analogies presented by Teschen disease with human poliomyelitis, it seems that a relationship cannot be established between the two infections. Until now, there has not been observed concomitant infection in human beings and animals . . ." It is our feeling, however, that although *identity* of the two infections is not probable there are sufficient grounds for projecting a possible *biological* relationship (reproductive, variational, evolutionary, etc.) between the two viruses.

Before amplifying the thesis of biological relationship, it would be helpful to compare in outline form various features of the two diseases (Table I). In this table, emphasis is placed on two overall aspects; first, on the similarity of these diseases, and second, on the unique characteristics which distinguish them from other virus diseases, with the possible exception of mouse poliomyelitis. At all times throughout this discussion, the limitation must be kept in mind that much fundamental knowledge of both diseases is still lacking, necessitating the bridging of gaps by theory. Sabin[19] gives an excellent review of the present-day position of the epidemiology of human poliomyelitis. His presentation will be used as a basis for epidemiological statements referring to human poliomyelitis in Table I. The statements on porcine virus encephalomyelitis are derived from information and discussion already advanced in the present work.

Biological Relationships

An examination of Table I reveals the striking similarities between human poliomyelitis and infectious pig paralysis which, we feel, project beyond pure coincidence. The only analogous disease known to exist in the animal kingdom is mouse poliomyelitis, a disease which shows remarkable similarity to human poliomyelitis.[29,30] *Immunological* relationship between the viruses of human and mouse poliomyelitis has not been established, and it is quite possible that the same situation will obtain with the virus of infectious pig paralysis. Certainly, more critical experimentation with the latter virus is necessary from every standpoint. Nevertheless, we feel that rich possibilities are inherent in adopting Burnet's ecological and evolutionary approach to the question of viruses.

In his challenging and stimulating exposition, "Virus as Organism," Burnet[39] has undertaken to weave a coördinated pattern out of the rather fragmentary proved knowledge which exists today concerning viruses. In view of the present unsatisfactory level of precise information (because of both the inadequacy of available methods, and the lack of comprehensive investigation with the means at hand), well-founded postulations like Burnet's indicate avenues of exploration which, if pursued, will provide distinct contributions and often shortcuts to the solution of pressing problems.

A basic tenet in Burnet's theory is that in the evolution of any specific organism, chance variation plays an important role, and that this variation carries with it the probability of extinction of the variant unless successful adaptation is established with the original or a new host, *i. e.*, a parasitism which permits survival of both the host and invader. Burnet also points out that this process of adaptation and survival involves participation of selected cells (respiratory, epithelium, nerve cells, etc.). Furthermore, often the viral activities concerned in the production of disease may not be related, and indeed, may be hostile to those activities concerned with the survival of the virus. For example, a mutant strain of a virus which is extraordinarily virulent may extinguish itself by rapidly killing its host, or the virus may become localized in tissues such as the central nervous system, from which there is little likelihood of its emergence and transfer to new hosts. All, or nearly all virus diseases of man, he believes, have derived from animal virus infections and even at present, transfers from animal reservoirs to man are taking place.*

It would appear then, that on such bases, the establishment of a parallelism between the viruses of porcine encephalomyelitis and human poliomyelitis (as is shown in Table I from the

*It is possible that the reverse also occurs, namely the establishment of human virus infections in animals. For example, according to Shope 25 the swine influenza virus may well have stemmed from the virus of human influenza.

standpoints of localization of the virus, experimental and natural transmission, community or herd reaction to exposure, pathogenesis, symptomatology and histopathology) justifies presentation of the hypothesis that the organism under consideration, and perhaps also that of mouse poliomyelitis, may be basically similar or may stem from the same parent strain. The known differences which exist among them are not impressive, at least at the present state of our knowledge, nor do they appear to impose serious obstacles to the thesis of common origin and biological relationship. The value of such an assumption has already been indicated. This value becomes very great if proved true, and only slightly less so if ultimately disproved.

TABLE I.—DISTINCTIVE ANALOGIES BETWEEN HUMAN POLIOMYELITIS AND PORCINE VIRUS ENCEPHALOMYELITIS

	Human Poliomyelitis	*Porcine Virus Encephalomyelitis*
Localization of virus	Virus found mainly in oropharynx, gastrointestinal tract and contents, and central nervous system; sporadically and very transiently in the blood. Absent in most other tissues and organs.	Thus far, found restricted to central nervous system, gastrointestinal tract and contents; rarely, if at all, in blood.
Natural transmission	Most important probably by way of digestive tract for both entry and exit of virus. Biting insects not incriminated.	More problematical. May be either by way of nasal or digestive tract, or both. Role of biting insects probably unimportant, if involved at all.
Experimental transmission	Highly species specific. Cannot be transmitted to other animals except mice (and only with the specially adapted Lansing strain), and monkeys.	Highly species specific. All attempts at transmitting disease to animals other than pigs have failed.
Community or herd reaction to exposures	Subclinical infections and resultant immunities to particular strains of virus occur widely during course of epidemic. Different strains of virus probably responsible for shift in usual endemic incidence in children to older age groups.	Subclinical infections and resultant immunity probable. Young pigs suffer most in enzoötic areas. Where disease is epizoötic and newly introduced, all age groups suffer. Strain plurality of virus probable.
Pathogenesis	Virus travels along nerve trunks to central nervous system.	Experimental transmission indicates nerve trunks are prime routes for conduction of the virus.
Symptomatology	Clinical infections may be abortive and culminate in recovery without paralysis. Non-specific prodromal phase followed by stages of hyperirritability and paralysis. Of paralytic types (spinal, bulbar, spinobulbar, encephalitic, meningitic), the spinal type with affections of the lower extremities is the most common.	Essentially the same as in human beings.
Histopathology	Predominantly involvement of anterior horns of spinal cord particularly at cervical and lumbar levels. Associated involvement of medulla, pons, midbrain, hypothalamus, and cerebellum.	Essentially a polioencephalomyelitis with predominant involvement of the anterior horns, particularly lumbar and cervical levels. Associated involvement of medulla, pons, peduncles, basal ganglia, and cerebellum.

Summary

The characteristics of porcine virus encephalomyelitis (infectious pig paralysis), a relatively new disease, are discussed. Striking resemblances between this disease and human poliomyelitis have been presented. It is suggested that a biological relationship may exist between the viruses of porcine virus encephalomyelitis and human poliomyelitis, with perhaps mouse poliomyelitis as a third member of the group, in the sense that these viruses were derived from the same parent strain.

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Chlordane Poisoning: Symptomatology and Pathology

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IN the few years since the advent of DDT as a popular insecticide numerous other chlorinated compounds have been developed and tested as insecticides. One of these is chlordane, of the empirical formula C10H6 Cl8 and, more specifically, 5,8-endo-dichloromethylene-4,9-dihydro-2,3,5,6,7,8-hexachloroendane. In the agricultural raw product, it is a thick syrupy material of pungent odor. It is formulated in many ways for the commercial market, the popular forms for use on livestock being emulsion concentrates and wettable powders. Chlordane has been suggested for use against many of the external parasites of domestic animals. Observations in this paper as to its toxic effects upon livestock were made as part of cooperative experiments with entomologists of the staff of the Kerrville, Texas laboratory, Bureau of Entomology and Plant Quarantine, Division of Insects Affecting Man and Animals.

Methods

The test procedures which induced these cases of chlordane poisoning have been described in detail by Bushland, *et al.*[1] The sheep and goats whose autopsies appear in this discussion were dipped in 1.5% concentrations of either chlordane wettable powder suspension or emulsion. The applications were repeated at 4-day intervals. The cattle herein described were sprayed at 2-week intervals with a 2.0% concentration of chlordane wettable powder suspension. Routine observations were made by the staff of the laboratory. Affected animals were turned over to the author as soon as discovered.

Observations

Case 1.—This was a yearling angora doe, dipped six times in chlordane wettable powder.

Clinical: This doe was found on the morning of April 27, lacking muscular coordination. There were clonic spasms of the masseter and levator palpebrae muscles, bilateral; total blindness with no obvious injury of the eye, internal or external. The pulse, respiration, and temperature were normal. A peculiarity was noted in that, if she were forced to move, the spasms disappeared completely, only to return as soon as she stopped moving.

At odd periods throughout the day circus movements were executed for brief intervals, the movements being accomplished either to the right or to the left, neither predominating. When allowed green food, the doe ate with apparent relish.

During April 28 the syndrome remained constant with that of the previous day.

About 6:00 a.m., April 29 convulsions began. All muscles of the body appeared to be involved. Profuse foamy salivation began at this time. Piteous, long, drawn-out bleating was almost continual. The animal was unable to coordinate in any manner when assisted to her feet. Death occurred at 10:45 a.m. with the body in a position of opisthotonos.

Post-Mortem Examination: Skin and external mucous membranes were cyanotic. Musculature was normal but cyanotic. There was moderate infestation of *Haemonchus contortus* in the abomasum. The liver was swollen and congested; the cut surface presented an appearance of cloudy swelling; the urinary system was nomral; the lungs were normal in consistency but did not collapse when the thorax was opened. The blood vascular system was normal; the heart in systole. Cross section of the spinal cord presented congestion.

Histopathology: In contrast to the marked nervous symptoms shown by the goat, only slight pathological alterations were found on routine histological examination of the brain. The brain was congested and there were a few small hemorrhages in the brain stem. In addition, the brain tissue appeared slightly edematous. Definite alterations of nerve cells were lacking in most areas of the brain examined, except in the white matter at the base of the cerebellum. Many of the large neurons in that area showed a marked degree of pericellular and intracytoplasmic vacuolation.

Both liver and kidney parenchymas showed a moderate amount of fatty change. In the liver there was moderate accumulation of small and medium-sized fat droplets within the parenchymal cells, chiefly in the peripheral and midzonal areas of the lobules. In the kidney, moderate accumulation of fine fat droplets was observed in many of the epithelial cells lining the proximal convoluted tubules. No other changes, that might be significant, were found in the sections examined.[1]

*United States Department of Agriculture, Agricultural Research Administration, Bureau of Animal Industry. In cooperation with the Bureau of Entomology and Plant Quarantine.

1 Report of histopathology, Pathological Division, BAI, to Division of Insects Affecting Man and Animals, BE&PQ, June 12, 1947 (Interoffice Communication).

Case 2.—An adult Angora doe, dipped eight times in chlordane emulsion.

Clinical: On being brought up for the eighth dipping the goat had become belligerent, butting other animals in the same pen. At the moment little attention was paid to this belligerency and the goat was dipped for the eighth time, then released to pasture.

Post-Mortem Examination: When found the carcass was partially decomposed. Time of death was set at approximately six hours after the eighth dipping. Judging by disturbance of earth around the carcass, death had occurred in agony. The position of the body was one of opisthotonos. Free blood was present at the mouth and nostrils.

Because of the time lapse between death and autopsy the cadaver could not be considered an ideal subject for study. Lesions reported are those about which there was no question. Suggestive appearances are omitted.

There were scattered subserous hemorrhages along the small intestines and cecum. The mucosa had disintegrated through decomposition. A few decomposing *Haemonchus contortus* were present in the abomasum. The urinary tract was decomposed, the lungs had apparently been highly congested before death, since they presented a considerable bulk; and the bronchi and bronchioles contained free blood.

Histopathology: Not examined.

Case 3.—This animal, a yearling Angora billy, was dipped six times in chlordane emulsion.

Clinical: Various nervous symptoms were observable when this goat was brought up for the seventh dipping. There were clonic spasms of the ocular and palpebral muscles. These spasms spread rapidly to other muscles of the body in a descending order. The goat suffered periods of blindness which lasted for brief intervals only. Seven hours later convulsions occurred regularly, when stimulated. Temperature, pulse, and respiration were normal. Before death foamy salivation began and the goat entered into a continuous convulsion which lasted until death two hours later. A position of opisthotonos prevailed at the time of death.

Post-Mortem Examination: There was severe infestation of *Haemonchus contortus*. The liver was slightly swollen, the cut section suggestive of cloudy swelling. Intestines showed hundreds of subserous hemorrhages, all of approximately seven to 10mm diameter. The intestinal mucosa was normal; the kidneys congested and somewhat swollen, and the brain and spinal cord were congested.

Histopathology: No definite microscopic changes were found in the kidney and liver sections.[2]

Case 4.—This was an adult mutton sheep in full fleece. It was dipped six times in chlordane emulsion.

Clinical: On the day after the sixth dipping this sheep was observed to be circling without reason and jumping imaginary objects. On closer observation it was discovered to be partially blind, being able to distinguish objects greater than ¼-inch diameter, but unable to perceive ordinary wire fencing. Pulse, temperature, and respiration were normal.

The next day the animal was totally blind, there was inappetence, and the ataxia continued. During the next two days this sheep suffered minor convulsive attacks. On the third day the appetite was normal. From May 1 to May 10 it appeared normal in all respects except that total blindness persisted. On the morning of May 10 the sheep was observed to be standing with its head drawn to one side, but without further disturbance. At approximately 9:30 a.m. a convulsion occurred and the animal died in agony.

Post-Mortem Examination: The carcass was in a position of opisthotonos, with no external lesions except cyanosis of skin and mucous membranes. The peritoneal cavity contained about one pint of serous fluid and about one-half that amount of fibrin clots. There was no fresh blood in the cavity and the peritoneum appeared normal.

Very slight traction on the abomasum produced a two-inch tear on the greater curvature. Stomach wall was very thin, seeming to lack a mucous lining. There were pin-point foci of inflammation scattered over the interior, being most numerous in the pyloric region. Pylorospasm was present as well as moderate numbers of *Haemonchus contortus*. The rumen, reticulum, and omasum were normal.

The small intestine showed severe enteritis with free blood in the lumen. There were several small areas of subserous fibrin deposits, apparently from previous hemorrhage. Blood vessels showed hyperpermeability by staining along their courses. (Autopsy had been performed within one-half hour of death, obviating post-mortem staining). The intestinal content was fibrous, not digested to the stage usually found. The large intestine was normal but filled with food in a very early stage of digestion, having an appearance of pale green sawdust.

The spleen was swollen, enlarged, and flabby. The liver weighed 2¾ pounds com-

2 Report of histopathology, Pathological Division, BAI, to Division of Insects Affecting Man and Animals, BE&PQ, July 30, 1947 (Interoffice Communication).

pared with a normal of slightly more than one pound. It was pale and friable; the gall bladder was moderately full, and the pancreas normal.

The lymph glands were swollen and edematous. The kidneys showed no gross pathology. The lungs were highly congested with small pneumonic foci. The heart was in systole. There were petechial hemorrhages on the atria and ventricles, particularly on the atria. The myocardium was of abnormal consistency. The endocardium was inflamed, that of the left ventricle showing diffuse hemorrhages. Small areas on the right side of the heart were also hemorrhagic. There was no affection of the valves. Blood vessels throughout the cadaver showed hyperpermeability by the staining of adjacent tissues.

The brain and spinal cord were moderately congested. The muscular and skeletal systems were normal.

Histopathology: There was well-marked fatty change of the liver parenchyma along with more severe degenerative changes in the central and midzonal areas of the hepatic lobules, namely centrolobular and midzonal necrosis of the hepatic parenchyma. The spleen was congested and the lung tissue was congested and atelectatic, but those changes are of doubtful significance.[3]

Case 5.—Adult mutton sheep dipped eight times in chlordane emulsion.

Clinical: This sheep appeared normal at the time of the eighth dipping, but when caught and dipped went into convulsions in the vat. It was thought at the time that in all probability inhalation pneumonia would result from the struggling in the vat. When released from the vat the sheep managed to work its ataxic away into the pasture.

Post-Mortem: Death was considered to have occurred some 14 hours after dipping, and judging from earth disturbance around the carcass, had occurred in agony. The body was in a position of opisthotonos. The skin and mucous membranes were cyanotic. The major portion of the gastrointestinal tract was normal. Subserous hemorrhages were present but confined to the small intestine. The stomach was normal, but contained moderate numbers of *Haemonchus contortus.*

The liver was swollen and slightly gray colored. The cut section indicated cloudy swelling. The gall bladder was distended, and the bile of normal consistency. The kidneys were congested and there was severe congestion of lungs with body (not dip) fluid accumulation in alveolar tissue. The brain and spinal cord were congested.

Histopathology: There was well marked fatty change of the liver parenchyma, along with more severe degenerative changes affecting the central and midzonal areas of the hepatic lobules.[4] No definite changes were found in sections of the kidney tissue.

Case 6.—Angora billy kid, dipped eight times in chlordane wettable powder.

Clinical: The last dipping preceded the onset of symptoms by one day. When first presented for observation, this goat was totally blind, the only ocular lesion being an old corneal scar. As long as it was allowed to remain undisturbed the animal seemed fairly normal. When suddenly stimulated while standing, as by pulling on the horns, he would fall abruptly, struggle spasmodically, and bleat piteously. If allowed to remain quiet he would recover equilibrium. The pulse, temperature, and respiration were normal.

During the next six days the symptoms remained rather constant. Each day the goat would, at intervals, circle either to the right or left for five to 10 minutes at a time. On the seventh day of observation the goat suddenly went into convulsions which lasted approximately 15 minutes, after which he relaxed completely. Casual observation from a distance of about 10 feet indicated that he was dead, and preparation was made for an autopsy only to discover he was still alive, although comatose. Convulsions occurred thereafter at about four-hour intervals, leaving the goat comatose at the termination of each seizure. Death occurred the next afternoon. The position was one of opisthotonos.

Post-Mortem Examination: The external mucous membranes and skin were cyanotic. There were tiny capillary hemorrhages at the palpebral margins and a healed corneal ulcer of the left eye. Peritoneal vessels were congested; the cavity being normal. There were brilliant petechial hemorrhage over the entire gastrointestinal tract except the stomach. Each hemorrhage was surrounded by a 3 to 5mm ring of staining and all hemorrhages were subserous. The stomach wall was thin, and the organ twice normal size, but not because of distension with food or gas, otherwise normal. There was moderate infestation of *Haemonchus contortus.*

The small intestine showed uniform petechiation, principally opposite the mesenteric attachment, spaced regularly at intervals of 1.5 inches. The wall of the intestine was thin, the food content undigested. One specimen of *Moniezia expansa,* approximately eight feet long, was observed.

3 See footnote 2.

4 See footnote 2.

The large intestine showed the same uniform petechiation as the small intestine. The food content was unusual in appearance. Alfalfa hay had been fed for several days prior to death. In the large intestine this hay had the appearance of having been ground to the consistency of corn meal, bleached lightly, and moistened slightly.

The liver was not greatly abnormal, but contained small foci seemingly necrotic. The gall bladder was normal; the spleen somewhat diminished in size, and urinary and respiratory tracts were normal. The heart was in systole, with petechiae in coronary fat at atrio-ventricular groove. Myocardium was swollen, endocardium hemorrhagic, and valves normal.

The brain and spinal cord were congested.

Histopathology: No definite pathological alterations were found in sections of liver, kidney, spleen, or heart tissue.[5]

Case 7.—This was a two-year-old, nonpregnant Hereford heifer. She had been sprayed four times at two-week intervals with 2% suspension of chlordane wettable powder, the last spraying being 10 days prior to death. She had been dehorned a few days previously, no evidence of infection.

Clinical: This animal was reported as abnormal on the morning of February 27, having been down, but able to rise. She was hauled to the laboratory by truck and observed to be blind when unloaded at 4:30 p.m. At 5:00 p.m. convulsions began and lasted until death. Piteous groaning, g r i t t i n g of the teeth, struggling, and nystagmus were obvious. The pulse was 180, respiration 30, temperature 111°F. at 6:00 p.m. A solution of calcium, phosphorus, and magnesium salts was given in an effort to control the convulsions, but without response. Death occurred at 6:17 p.m. in a position of opisthotonos.

Post-Mortem Examination: The carcass was extremely emaciated, the fat gelatinous. Two weeks previously the heifer had been in good condition. The stomach was normal. Numerous subserous petechial hemorrhages were observed throughout the intestine. The liver was swollen, congested and yellowish. Kidneys were of somewhat boiled appearance; the lungs normal. Many subepicardial petechiae were found along coronary vessels and also subendocardial hemorrhages in left ventricle. The brain was congested.

Histopathology: Liver degeneration was well advanced, all lobules being affected. Large fat droplets were present throughout each lobule, most prominent in peripheral and midzonal areas. Most of kidney was normal; tubules showed cloudy swelling with a few casts. No other pathological changes were noted. Cerebellar and brain stem sections showed congestion.

Case 8.—A yearling Hereford heifer which received same treatment as Case 7.

Clinical: She was found down on the morning of February 28. That afternoon she was observed in convulsions. There were nystagmus, gritting of the teeth, and piteous groaning. The ground around the animal was well packed, indicating protracted recumbency. Temperature was 109.6°F., respiration 40, pulse 150. Bloodstained, tightly compressed feces had been passed. The heifer was loaded on a truck and hauled about one-half mile, after which time she was dead. The body at death was in a position of opisthotonos.

Post-Mortem Examination: The carcass was extremely emaciated, the fat gelatinous. Two weeks previously the heifer had been in good condition. The omentum contained numerous hemorrhages scattered in its parietal surface. The liver was swollen, friable, and congested. Dilated vessels on the peripheral border of the intestine indicated incipient hemorrhages. The kidneys were normal. The lungs normal and well inflated. Numerous subepicardial petechial hemorrhages were found along coronary vessels, as well as small thrombi attached to ventricular endothelium. The brain was grossly damaged in removal.

Histopathology: The liver showed beginning fatty degeneration, most prominant in peripheral and midzonal areas.

Case 9.—Adult Hereford cow receiving the same treatment as Cases 7 and 8.

Clinical: She was discovered down a few minutes after Case VIII, but had not been recumbent for so long a period. She was semiconscious of activities in her vicinity. The ground around her was extensively disturbed by her struggles. Her motions were convulsive, the eyes rolling, the mouth half open in agony. Bloody feces had been passed. Temperature was 103.6°F., pulse 150, respiration 45. The cow was loaded for trucking but died in less than 30 minutes in opisthotonos.

Post Mortem Examination: The carcass was thin, but not emaciated. The abomasal mucosa was reddened, the stomach otherwise normal. There was a mucoid enteric content, but no hemorrhages. The kidneys were normal, the liver swollen, but not easily torn. Subepicardial petechiae were present along the coronary vessels. The lungs were normal; the brain damaged in removal.

Histopathology: Liver l o b u l e s showed cloudy swelling and small areas of peripheral fatty degeneration.

5 See footnote 2.

Discussion

On the basis of this limited number of cases, certain symptoms and lesions may tentatively be considered as characteristic of chlordane poisoning. In acute clinical cases the onset is sudden. If not already dead when found, the animal is usually down and in agony. Piteous bleating or groaning, grinding of teeth, blindness, violent paddling, opisthotonos, and ultimate cyanosis just before death are regularly observable. In subacute to chronic cases there is no clear-cut beginning, partial to complete blindness and locomotor ataxia appear gradually. Affected animals may circle, jump imaginary objects, stagger, or suffer periodic convulsions. The only other external manifestation of poisoning is the cyanosis immediately preceding death.

Relatively consistent autopsy findings are the petechial and larger hemorrhages, characteristically subserous in the large and small intestine, and subepicardial in the heart. Some swelling or enlargement of the liver, with histopathological alterations, is usually present. Congestion of the brain and spinal cord is fairly constant.

Apparently petechiae may be found in any area of the body in chlordane poisoning, but not regularly except in the heart and intestines.

Less consistent, but frequently seen, is subendocardial hemorrhage (usually diffuse). Found only occasionally are erosion of gastric mucosa, peritoneal effusion, enlarged spleen, and gastroenteritis. In occasional cases the lungs failed to collapse when the thorax was opened.

Since only limited histopathological examinations were performed, characteristic lesions in that respect are not complete. Fatty changes of the liver seem relatively constant: in the sheep there also was central and midzonal necrosis of the hepatic lobules. In one instance, in a goat, involvement of the kidneys with fat deposits in the area of the proximal convoluted tubules has been observed. In the brain of the same goat, neuron involvement, hemorrhage, and congestion were noted, while other brains examined revealed only congestion.

Somewhat of a problem presents itself to the clinician and the pathologist in arriving at a differential diagnosis. The symptoms and/or lesions of chlordane poisoning are similar in certain respects to those found in poisonings by sodium chloride, sodium nitrate, chloroform, cockle bur, DDT, santonin, and chlorides in general. The motor ataxia, death in agony, subserous hemorrhages, and liver damage are of particular note. Since sodium chloride in sufficiently large dosage can cause death in animals, the clinician and pathologist must consider the similarity of symptoms. The history should help in formulating a diagnosis. Gastroenteritis, present in sodium chloride poisoning, is not usually present with chlordane, nor is there diarrhea in chlordane poisoning.[2,3,4] The probability of chloroform poisoning is remote and history should clear the point.[5] It will also be wise to differentiate in certain seasons between chlordane and cockle bur poisoning, since convulsions occur after consumption of *Xanthium orientale*.[6]

From the clinician's viewpoint it will not be so easy to differentiate DDT and chlordane poisonings. Spicer,[7] *et al.*, after inducing deliberate DDT poisoning in goats, carefully recorded the symptoms and lesions. Both poisonings have resulted in nervousness, some muscle tics, locomotor ataxia, and convulsions. DDT-poisoned goats recovered if the dose was discontinued before extensive symptoms were noted, while animals poisoned by chlordane do not seem to recover, once they have manifest toxic symptoms. In DDT-poisoning, while the eyes showed turbidity, there was no apparent blindness, even just before death. Partial to total blindness is present from the beginning in chlordane affected animals, without visible lesions of the eyes. In DDT poisoning there was moderate tendency to viciousness, while this was noted only once in the cases herein described.

In general, animals poisoned by DDT, once they had entered into convulsions, remained so until death or recovery. Those affected by chlordane may have periodic convulsions at considerable intervals of time.

Differentiating DDT and chlordane poisoning on autopsy is less difficult than the clinical differentiation: The petechiation in most chlordane cases is in direct contrast to the lack of peritoneal lesions, reported by Spicer, *et al.* Involvement of the liver and heart in chlordane poisoning is frequent, but unusual with DDT.

It must always be borne in mind by the investigator, that many substances other than those herein discussed may, in toxic doses, suggest chlordane poisoning by symptoms or lesions. No one or two symptoms or lesions are sufficient to make a positive diagnosis of chlordane poisoning.

At present there is no direct chemical method for the determination of chlordane in tissues or body fluids. An approximation may be made by determining the excess organic chlorine content and multiplying by the factor 1.44 to obtain the chlordane equivalent. The interpretation is not reliable since it is only the organic chlorine that is determined, not chlordane. Diagnosis of chlordane poison

ing must be made on the basis of the history, symptoms, and lesions, and can be verified only partially by analytical methods.

Summary and Conclusions

Nine cases of poisoning by chlordane reported in detail as to symptomatology and pathology. The symptoms and lesions are summarized in Table I. The use of chlordane on livestock is not without danger. The concentrations and frequency of applications in these experiments offer extreme examples. Poisoning by chlordane will probably be experienced in the field only as a result of carelessness in application of the insecticide or in its storage where animals may accidentally consume it.

TABLE I—SUMMARY OF CLINICAL AND AUTOPSY OBSERVATIONS IN NINE CASES OF CHLORDANE POISONING

	CASE NUMBER								
	1	2	3	4	5	6	7	8	9
Clinical:									
Number of applications	6	8	6	8	6	8	4	4	4
Duration of illness—days	2	½	1	7	11	½	½	2	1
Emulsion (E) or wettable powder (P)	P	E	E	P	E	E	P	P	P
Ataxia, motor	x[1]	—[2]	x	x	x	—	x	x	x
Blindness	x	?[3]	x	x	x	?	x	x	x
Circus movements	x	?	—	x	x	?	x	?	?
Convulsions	x	x	x	x	x	x	x	x	x
Bleating or groaning	—	?	x	x	—	?	x	x	x
Inappetence	—	?	x	x	x	?	x	x	x
Cyanosis before death	x	?	x	x	x	x	x	x	x
Death in agony	x	x	x	x	x	x	x	x	x
Belligerency	—	x	—	—	—	—	—	—	—
Autopsy:									
External hemorrhages	—	x	—	x	—	—	—	x	x
Peritoneal effusion	—	—	—	—	x	—	—	x	—
Petechiae, small intestine	—	x	x	x	x	x	x	—	—
Petechiae, large intestine	—	x	x	x	—	—	x	—	—
Healed petechiae	—	—	—	—	x	—	—	—	—
Enteritis and/or gastritis	—	—	—	x	x	—	—	—	x
Gastric hypertrophy	—	—	—	x	x	—	—	—	—
Erosion, gastrointestinal	—	—	—	x	x	—	—	—	—
Collateral vessel staining	—	—	—	x	x	—	x	—	—
Swelling, liver	x	?	x	—	?	x	x	x	—
Necrosis, liver	—	?	—	x	x	?	—	—	—
Spleen, enlarged	—	—	—	—	x	—	—	—	—
Spleen, diminished	—	—	—	x	—	—	—	—	—
Kidneys, congested	—	—	x	—	—	x	x	—	—
Heart, petechiae, epicardium	—	—	—	x	x	—	x	x	x
Heart, petechiae, endocardium	—	—	—	x	x	—	x	x	—
Brain, spinal cord, congested	x	—	x	x	x	x	x	?	?
Lungs, filled with air	x	—	—	—	—	—	—	x	—
Lungs, congested	—	x	—	—	x	x	—	—	—

[1] x=present.
[2] —=not present.
[3] ?=condition of carcass or of finding animal prevented observation.

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Veterinary Problems in Poultry Production

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Isolation of Agent of Infectious Sinusitis in Turkeys

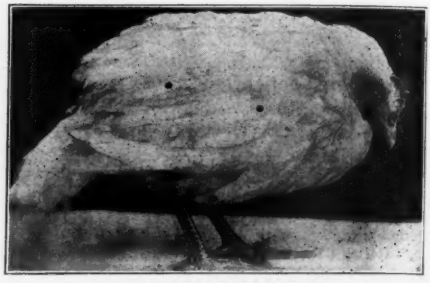
During the past few weeks, three groups of research workers have independently reported the isolation of a bacteria-free agent as the cause of infectious sinusitis of turkeys. Groupe, Winn, and Jungherr of the University of Connecticut (*Proc. Soc. Exp. Biol. & Med.*, 67, p. 397, 1948) demonstrated the filterable agent by propagating it in the yolk sac of developing chick embryos and subsequent transmission to turkeys. The agent studied by them passed a Berkfeld V filter, but did not readily pass Berkfeld N or Seitz E K filters. Previously Hart (*Austral. Vet. J.* 16, 163, 1940) and Hinshaw (Calif. Agric. Exp. Stat. Bul. 613, 1943) succeeded in transmitting the disease by injecting sinus exudate from infected turkeys into the sinuses of normal turkeys. They were not able to filter the causative agent through collodion membranes, Chamberlain or Sintered glass filters, but they did not try chick embryos.

At the annual meeting of the Poultry Science Association held at Fort Collins, Colorado, June 21 to 24, 1948, Jerstad and Hamilton of the Western Washington Experiment Station and Hitchner, of the Virginia Experiment Station each presented a paper describing their studies on the isolation of a similar agent from turkeys in Washington and Virginia. Both Jerstad and Hamilton, and Hitchner reported that the same agent causes both sinusitis and air sac involvement.

At the annual meeting of the Poultry Science Association held at Fort Collins, Colorado, June 21 to 24, 1948, several papers of interest to veterinarians were presented. Two of these on the causative agent of infectious sinusitis of turkeys have been reported in the foregoing. Abstracts of these papers will appear soon in Poultry Science.

Edgar and Williams of the Alabama Experiment Station reported that 99% of the mosquitoes collected in Alabama poultry houses were the common pest mosquito of that area, *Culex quinqnefasciatus*. It was shown by them that this mosquito has a high preference for avian blood. Evidence was presented that this mosquito may cause a loss in egg production in Alabama during the peak of the mosquito season.

Edgar and King of the same station studied 50 mixtures of seven different insecticides on 140 pens totalling 5,000 chickens, all naturally infested with lice. Insecticides tried were DDT, methoxy DDT, benzene hexachloride, chlordane, sulfur dust, sodium fluoride and



A White Leghorn infested with head lice.

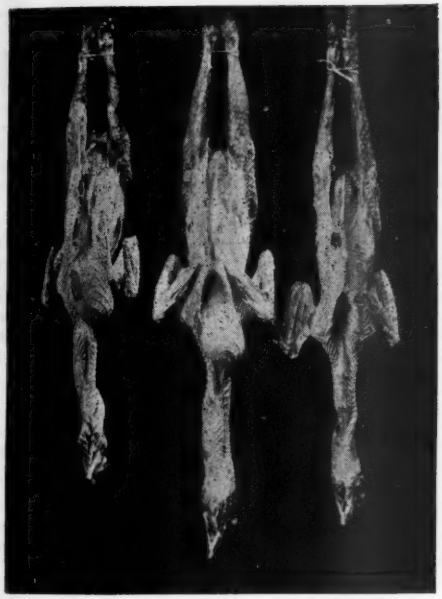
black leaf 40. As used in their studies, of all the compounds tested, sodium fluoride gave the most complete control. Sulfur dust proved the most economical. There was no evidence of a drop in egg production or objectionable flavor or odor of eggs sampled during the treatment with benzene hexachloride or sulfur. The economic effect of lice was emphasized by the fact that six pens of louse-free control birds laid 17% more eggs than the respective body-louse infected pens during the first nine month laying period.

A symposium on Newcastle disease (avian pneumoencephalitis) centered on methods of vaccination and air transmission was a featured part of the program. In the symposium, the tendency towards the use of vaccines made from live attenuated viruses was evident. The disease may be air-borne according to the report of DeOme and his coworkers at the University of California. The first report on the transmission of the disease by air is given by DeLay, DeOme and Bankowski in *Science* 107, p. 474, 1948. In this paper they report the recovery of the virus from air contaminated as the result of a natural infection. Samples of air collected in a poultry house where the disease was known to exist were used for the transmission of the virus to chicks. This is believed to be the first report of the isolation of virus from air contaminated as the result of natural infection.

Most of the reports on the use of sulfonamides for the control of coccidiosis in chickens have referred to *Eimeria tenella* infections. In a report by Grumbles and Delaplane (Proc. U. S. Livestock San. Assn. 1947, p. 285) the value of sulfaquinoxaline against *Eimeria necatrix* is discussed. Their results show that this drug fed at the rate of 0.05% intermittently or at the rate of 0.0125% continuously in the mash is of value in preventing losses of chickens by death and retarded growth from *Eimeria necatrix* infection.

Tuberculosis in Poultry

It is evident from the reports of Senior and Kuttler (Proc. U. S. Livestock San. Assn., 1947, pp. 267-274) that tuberculosis of poultry is still an economic problem in some sections



Carcasses which indicate tuberculosis

of the United States. These reports also emphasize that the swine industry is still suffering from avian tuberculosis on farms where both chickens and swine are being reared.

Senior reported that 269 (40%) of 653 flocks of chickens tested were found to be infected; and that 153 (35%) of 432 herds of swine tested with avian tuberculin were infected. Eradication of tuberculosis of poultry is largely dependent on education of farmers on the best methods of eliminating the disease from chicken flocks. Veterinarians in avian tuberculosis areas can do much to further such a program by acquainting their clients with the recommended procedures. These methods are available in textbooks and in many bulletins. It is also recommended that Doctor Senior's report be read. The most important factors in preventing this disease on chicken farms are, sanitation, segregation of all young stock from birds over one year of age, and the purchase of all replacements as day-old chicks.

In a trial at the Georgia station sulfamethazine at 0.25% level in the mash was determined to be more effective in controlling mortality from coccidiosis (*E. tenella*) than sulfaquanidine at 1% level.

Avian pneumoencephalitis was discovered recently in a flock of 500 week-old poults in Illinois, the first discovery of the disease in turkeys in the state. The poults had been purchased as day-old stock from out of the state. The mortality was more than 25%.

The Wene Laboratories, Vineland, N. J., have been given a federal license for the manufacture of a vaccine for the prevention of avian pneumoencephalitis. It is marketed as "Newcastle vaccine, embryo origin, killed virus," and is recommended by the producer for the vaccination of healthy birds from four weeks of age to laying age.

Three Remedies for Louse Infestation

Three of the new chlorinated hydrocarbon insecticides—chlordane, gammexane and DDT—were tested against poultry lice—*Menopon pallidum, Goniocotes hologaster,* and *M. biseriatum* by Creighton *et al.* at the Florida station.

Benzene hexachloride (gammexane) was dusted in the region of the vent and worked down to the skin. Heavily infested birds were completely freed of lice by this treatment and residual protection persisted for several weeks.

All three insecticides were applied to the soil in poultry yards in quantiites ranging from two to 10 pounds per 100 square feet. The results were sensational and lasting. After five weeks the birds were still free of lice although they were infested with more than 100 lice per bird when placed on the treated soil.

In this soil treatment test chlordane and benzene hexachloride were somewhat more effective than dichloro-diphenyl-trichloroethane (DDT).

Abstract

Toxity of Lead Arsenate

Because lead arsenate is commonly used in agriculture as a spray, poisoning in farm animals as a result of eating grass or other vegetation contaminated by the spray or of access to containers in which the spray materials are stored is not rare. Voigt, Edwards, and Johnson[35] of the School of Pharmacy, University of Florida, conducted several experiments to determine the lethal dose of lead arsenate for chickens, rats and rabbits.

As a result of these experiments they concluded the LD 50 for chickens is 450mg per kilogram, live weight; for white rats, 825mg/kg, and for rabbits, 125mg/kg. Deaths occurred in from 10 days to three weeks after single doses of these amounts. No attempts was made to determine the cumulative effect of small amounts of the poison consumed over a period as might happen in animals grazing contaminated grass, e. g. in an orchard.

Bulletins, Circulars, Reports, etc.

Small Farms in Wisconsin.—Bul. 473 University of Wisconsin Exp. Sta., Madison.

Pasteurizing Milk at Home.—Special Circ. No. 8. University of Wisconsin, Extension Service, Madison.

Brucellosis of Swine.—Circ. No. 781. USDA. For sale by the Superintendent of Documents, Washington 25, D. C. Price, five cents.

Better Service from Home Equipment.—Extension Bul. 303. Purdue University, Lafayette, Ind.

Control of Abortion and Sterility in Cattle Due to Trichomoniasis.—Circ. 249. University of Wisconsin Ext. Service, Madison.

Scientific Feeding of Farm Animals.—Includes feeding standards and tables for balancing rations for farm animals. Armour and Company, Chicago 9, Illinois.

How to Clean a Milking Machine.—Complete, detailed instructions, supplemented by numerous illustrations, of this important measure in the production of wholesome sanitary milk. Circ. 378, University of Wisconsin Ext. Serv., Madison.

Vitamins in Medicine. — This 70-page monograph deals with the symptoms and lesion of avitaminoses due to deficiencies of vitamins A, K, E, thiamine, riboflavin, nicotinamide, pyridoxine, pantothenic acid, biotin, folic acid and ascorbic acid in man and laboratory animals.

35 Voigt, J. L., Edwards, L. D., and Johnson, C. H., Acute toxicity of arsenate of lead in animals. J. Am. Pharmaceut. Assn. 34, pp. 122-123. (March) 1948.

Victory Gardener's Hand Book.—Treats of insects and other pests, diseases, insecticides, fungicides, etc. Includes many illustrations and descriptions of garden pests. Miscellaneous publication No. 525. USDA, Washisgton 25, D. C.

Foot-and-Mouth Disease.—Report by a committee of the California Senate. This is an extremely valuable monograph of 445 printed pages. It deals briefly with the character and symptoms of foot-and-mouth disease, and with the history of the disease in this country, particularly of the outbreaks in California. It gives by long odds the most complete account of the present Mexican outbreak of the disease, that is available to the public from any source. No price is stated for the report. Possibly, while the supply lasts, it may be had by addressing the Hon. Goodwin J. Knight, President of the Senate, Sacramento, California. Since apparently only 20 thousand copies were printed the supply will be exhausted quickly.

Save Grain by Controlling Internal Parasites.—Internal parasites of livestock can be controlled to a highly rewarding degree, resulting in less waste of grain and other feeds and offering better opportunity to maintain sound foundation animals for future expansion of livestock production when grains are again plentiful.

The publication points out that internal parasites of livestock cause an annual 125 million dollar loss, and brands these parasites as "the most treacherous of all livestock pests because their hidden work goes on day and night. At no time can farmers afford to support these parasites," the publication says. "Need for control is especially called for now because of the world-wide demand for food to feed people."

The leaflet outlines a series of treatments and other measures which will help control the most injurious species of internal parasites attacking sheep, cattle, horses, swine, and poultry. It advises farmers and ranchers about "the right control material and where to get it, the correct formula to use, the proper method of treatment, and the time when parasites are most vulnerable." Office of Information, USDA, Washington 25, D. C.

Wisconsin Corn Hybrids.—This is in no sense a veterinary bulletin, but it illustrates forcibly a matter that has provoked caustic comment from many veterinarians, viz, how very far plant breeding has advanced beyond anything yet dreamed of by animal geneticists. If an animal breeder can produce one champion in a hundred he is the toast of an industry, uninterested in how many siblings have skeletal "ties" or udders that sag to the fetlocks, or carcinogenic eyes, or white heifer disease or hypogonadia, or even whether the champion is a shy or prolific breeder.

Plant geneticists are as interested in disease resistance as in production and for the good reason that disease lowers if it does not prevent production. Inherent shy breeding in animals is not classed as a disease but it makes the treatment and prevention of reproductive diseases more difficult and far less effective, yet it is a fault of many strains or families of purebred animals, nor is a dangling udder a disease but it is, so far as geneticists are concerned a completely overlooked contributing factor. And so one might go through a considerable list including weak feet, narrow pelves, horns, a tendency to develop milk fever, a tendency to bloat, a tendency to produce victims for "baby pig diseases" and a tendency to transmit lethal recessives and sublethal recessives that are diadvantageous, etc.